American Machinist / Metalworking Manufacturing

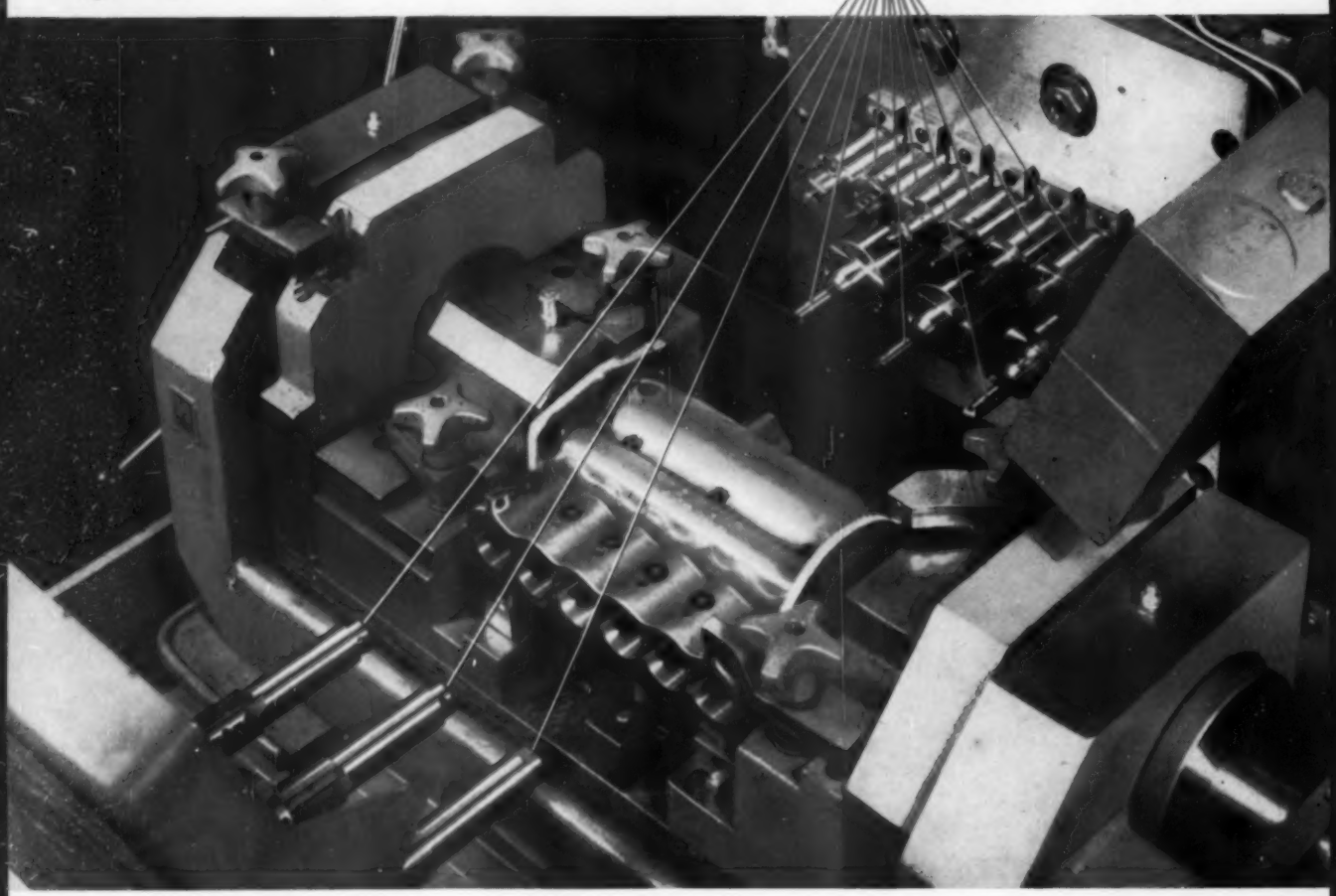
A McGRAW-HILL Publication • Seventy-Five Cents AUGUST 8, 1960

Must reading for the Exposition:
ABC's of TAPE CONTROL

Plug-in modules simplify automatic tape control of turret lathe—see page 76

- **Triple threat approach to honeycomb,** page 69
- **Portable gaging stations,** page 78
- **Grinding miniature bearing races,** page 80

12 HEADS
are better than one



Heald Bore-Matic finishes up to 27 DIFFERENT SURFACES at a single loading

• In the setup shown above, 27 surfaces of 15 bores are done on one machine at a single loading—a Heald Model 222 Bore-Matic with Multi-Spindle heads with a trunnion type fixture. Six deep 3-step bores are done with the three left-hand heads with only one index of the cross slide. After indexing the fixture to hold the work vertical, nine right-angle bores are done at a single pass with the right-hand heads. The same machine also handles four-barrel pump housings, simply by removing one of the left-hand spindles and three of the right-hand spindles.

On multiple-hole Borizing jobs such as this, interchangeable Multi-Spindle Red-Head boringheads permit many operations to be combined on a single machine, with minimum indexing of the work and positive spacing between bores. Your Heald engineer will be glad to give you complete information.

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COVER:

Control system in plug-in modules provides contour control on Gisholt Factrol 101 turret lathe. See page 76.

American Machinist / *Metalworking Manufacturing*

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METALWORKING REPORT

Significant current developments in tooling and production processes

CUTTING

Tiny Holes at Any Machine

A new miniature air-turbine attachment will drill hole diameters from 32 down to 1 thousands at any standard drillpress, jig borer, miller, or lathe. The unit is being introduced by Milburn Machine Wks, Baldwin, N Y, under the name, Turbo-Drill.

The turbine drives the miniature spindle at 1000 rpm for each pound of air pressure available, reaching speeds of 3500 to 120,000 rpm. A set of needle valves acts as a vernier throttle to allow close speed control. The attachment has a ½-in. shank for mounting in standard machine spindles.

Vertical feed control is also by air, and feed pressure is maintained at a constant, pre-set value. Maximum downfeed is ⅛ in.; bearings are air-oil types.

More on Ultrasonic Spark

The combination machining technique, ultrasonic vibration added to electric-discharge machining, worked out by Federici of Italy (AM/MM—Aug 10 '59, p2), has had some experience. Results are good, with surface finishes down to 10-12 micro-in. This is reached with the slowest of six cutting speeds available.

Ultrasonic frequency is up to 40,000 cps, produced by a servo in the machine head. Amplitude is only 0.001 to 0.0015 in. Normally, the ultraonic unit is synchronized with the spark frequency so the vibration will help flush out the eroded particles that tend to clog up on the working surface.

For non-conducting surfaces that cannot be eroded, the tool is operated simply as an ultrasonic drilling machine. The same equipment can build up a hard surface of tungsten carbide or other materials with a special accessory that makes the unit a spark-deposition machine.

Warping Contours Honeycomb

One way to simplify contour machining on honeycomb is to warp the material into position so its surface forms a reverse contour, then machine flat across the warp. When the honeycomb is unclamped and relaxed, it falls back into original shape, but with the contour included.

This technique makes machining easier and makes tool selection much simpler. Convair (Ft Worth) freezes the aluminum honeycomb into warped shape at a standard machine, then grinds it. No special positioning or templet following is required.

N/C Payoff

Five numerically controlled machines at Republic Aviation are kept so busy over a 24-hr-day, 6-day week, that only jobs which show *greater* than 75% reduction in machining time (compared to conventional machining) can be scheduled. Machining-time reductions are as high as 90-95%, tooling costs are down 50%.

James J Childs, chairman of Republic'c N/C program says inspection gains, too—100% inspection is required only on the first part.

Convair (Ft Worth) also has profitable results: One-piece integrally stiffened bulkheads are N/C profiled in 20 hr, vs 175 hr for 100-pc riveted bulkeads, and $1000 overlay templets are not needed.

Convair also reports a sharp drop in programming time; one hour of N/C machining time now needs 15 hr of programming time—originally the figure was 40 hr. One main reason—the APT system (AM—Mar 9 '59, p106).

HEAT TREATING

A Case of Hardenability

If you've been picking steels for case hardening on the basis of how well the core of the part will harden, Climax Molybdenum disagrees with your theory. After research since 1951 on case hardenability, Climax has produced a 136-page book which points out clearly that hardenability of both case and core is essential for proper selection of the optimum grade of steel and its control.

The old theory is that core hardenability alone was an adequate basis for selecting a steel for case hardening, because adequate core hardenability insures adequate case hardenability. According to the book, "Atlas, Hardenability of Carburized Steels," this theory is not necessarily correct. With more than 125 charts that show the effect of cooling rates and distances from the end of specimens on their Rockwell hardness, the book shows that both case and core hardenability must be checked. The study covers carbon, molybdenum, nickel-chromium, nickel-chromium - molybdenum, and other steels.

The book is published by Climax Molybdenum Co, div of American Metal Climax, Inc, 1270 Avenue of the Americas, New York 20.

INSPECTION

Measure With Lights

Three neon lamps mounted behind a cutout plate on a French dial comparator simplify gage reading by showing +, −, or = when work is located in the gage for comparison to a preset dimension. This can both speed inspection and make accurate work possible by unskilled operators.

The gage, made by S A LIP in Paris, has a range of 0.010 in. of plunger travel, accuracy to ±0.0001 in., and a plunger raised by a cable release when parts are to be inserted and removed. Master settings are made with gage blocks. Contact pressure of the device is 3 oz.

Mechancial linkage amplifies readings to operate lamp contacts.

WELDING

Big Pipes Welded Fast

High-frequency welding has tackled a big job at Calgary, Alberta, where it is turning out 18 to 36-in.-OD pipeline pipe at speeds ranging from 25 to 75 fpm, depending on the wall thickness. Half-inch-wall pipe moves through at better than 30 fpm.

Big Inch Pipe Corp, Ltd, says its new plant has no need for the U-ing and O-ing presses that normally form the steel into cylinders. In one machine, the steel plate skelp is side trimmed to exact width, then continuously formed into a cylinder as the longitudinal seam is welded by the high-frequency process.

Other advantages are that the skelp doesn't have to be cleaned before welding, and, as no metal is added to the joint, there are no welding electrodes or flux. The new pipe mill is the largest ever built by Cal-Metal Corp, Torrance, Calif.

FINISHING

Improved Paint-on-Aluminum

Chemical reaction produces an organic surface on aluminum products that has a great compatibility with paints and improves adhesion. Chemlock 720, made by Hughson Chemical Co, Erie, Pa, is treatment that improves all air-dried finishes and baked finishes.

It is a cathodic treatment that prevents base-metal corrosion. Adhesion is said to be so strong that paint film on precoated aluminum will fail cohesively rather than strip off under impact.

And Now—Instant Nickel

Nickel chloride in liquid form (electroplaters have generally purchased the material as powder, then mixed to suit) is now available from Hanson-Van Winkle-Munning, Matawan, N J. As a liquid, it is instantly miscible, requires no stirring or premixing, and can be poured directly into the plating bath to bring the nickel-chloride content back up to required strength. One gallon of the liquid is equivalent to 6 lb of the dry powder.

Aside from convenience, the producer says the liquid should reduce problems in storage, handling, and dissolving.

ASSEMBLY

Nylon-Metal Welds

Nylon gears are bonded to metal shafts and threaded screws are bonded into nylon-and-metal assemblies with a new two-step process developed by Plastic Associates, Laguna Beach, Calif. Prime advantage is that the bond makes un-

THE OUTLOOK

Metalworking production is holding steady through the usual summer slowdown. The AM/MM Index for July is 107, same as in June. But with increased defense spending almost certain, the metalworking industry should pick up considerably in the fourth quarter. Brightest spot in the metalworking picture now is the continued increase in tool and die die orders. *See page 63.*

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necessary the complicated mechanical intelocks usually required because nylon is so slippery.

An epoxy paste chemically unites with the metal surface, then a separate solvent softens the nylon and allows nylon molecules to blend with the epoxy as it hardens. This goes on at room temperature.

The result is a tough, shock-resistant union within a few hours.

MATERIALS & COMPONENTS

Fiberglass Fasteners

Plastic screws and nuts that really hold up after repeated use have been developed with a special molding and machining process at Pam-Pro Plastics, Menlo Park, Calif. The Fiberglass fasteners in ¼-20 sizes are intended for missile and rocket applications where heat and abrasion resistance are most important.

The material is a glass fabric impregnated with phenolic resin, which can be low-pressure molded or high-pressure laminated. Its action at high temperature is slow, steady vaporization, which tends to make the material self-cooling. Strength is claimed to be unusually high for an abrasion-resistant material.

Cleaner Paints

A soil-retarding material introduced by du Pont can be sprayed, brushed, wiped, or rolled on any painted surface to fill any irregularities so well that there is nothing left to which dirt can stick. It is a concentrate based on colloidal silica, reduced with 14 parts of water to make a thin fluid that spreads easily.

The coating dries in 15 minutes to a hard, thin layer. No special surface treatment is required, except that the surface to be coated must be clean to start with.

MANUFACTURING CONTROL

Finishing Costs

A survey being undertaken currently by the National Association of Metal Finishers is probing into operating costs throughout the US and Canada. One aim: To see if cut-throat competition between many small firms is a result of ignorance of the management as to true operating costs. The survey is expected to provide a better yardstick for more efficient management in the future.

Next: Mechanized Training

Here's a way to train an operator for complicated assembly work—even operations that will not be repeated often enough for the worker to memorize the routine. The system uses an audio-visual work instructor that synchronizes directions prerecorded on color slides and tape. These aids are set up at riveting or soldering machines.

The device is about the size of a portable TV set, and mounts at the work station to display a color picture 5½ x 8 in. of each function. At the same time, the tape recording gives instructions through an earphone. Picture is shown when tape covers that job.

The system was developed by Applied Communication Systems, Culver City, Calif, to eliminate written instructions and blueprints. Time standards for the operations are built into the sound tape, but the instructions can be altered to suit the worker's proficiency. The builder also has a work station into which the audio-visual device fits.

MATERIALS HANDLING

Piggyback (and Modular) Trucks

Two similar systems, improvements on the conventional piggyback method of hauling trucks and trailers by rail between major cities, have been announced by Railway Express and the B & O. They both use demountable trailers that are lifted off their chasses and loaded flat on rail cars.

The system works this way: A trailer calls at your plant, picks up the load, and goes to the rail yard. A crane lifts the trailer box off the chassis and places it on the flatcar, where special fasteners hold it safely. At its destination, the box is lifted onto another trailer chassis, then trucked to the destination.

The American Express trailer-containers are 8 x 8 x 20 ft, while the B & O units are 36 ft long. Eliminating the chasses saves railcar space and improves stability.

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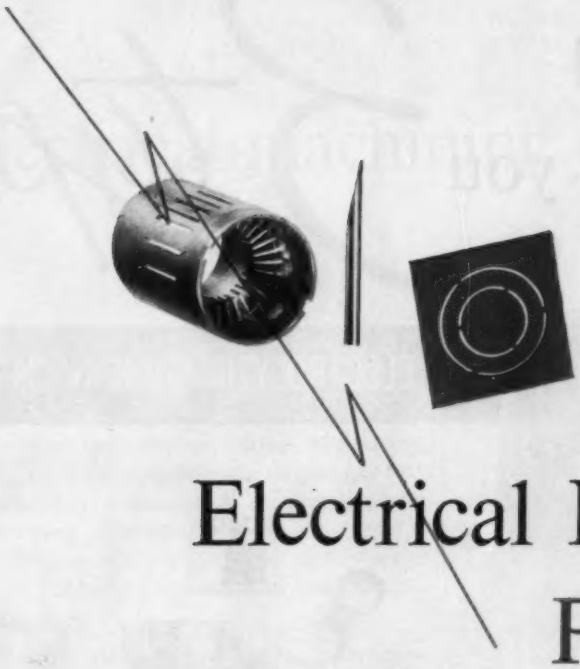


Electrical Machining Perspective

Another bright star is firmly fixed in the constellation of basic machining methods. The star is ELECTRICAL MACHINING. Within a brief span of ten years it has developed from a laboratory process to machine tool stature, taking its place beside milling, drilling, turning, grinding, planing and forming. Electrical machining differs from other types of metalworking in that electrical energy is applied direct to the machining of metal parts. The process is divided into three distinct categories:

1) Electrical Discharge Machining
2) Electrolytic Machining
3) Electro-Chemical Machining

Where can electrical machining be applied to advantage?

In general, electrical machining removes many limitations inherent in chip making machines. The electrical methods can be applied in varying degrees across the complete field of metalworking. They are highly advantageous in machining metals that are too hard or too tough for cutting tools . . . machining without thermal change or cutting forces . . . machining fragile structures without the tool touching the work . . . machining dissimilar metals without loading the tool . . . machining odd shapes by feeding a static tool through the work . . . machining curved axis holes . . . machining carbide with drastic reduction in diamond cost. These and other capabilities open new vistas for designers and manufacturing engineers.

What are its opportunities?

Opportunities are numerous in both production shops and toolrooms. In die shops, for example, hand finishing of cavities can be eliminated. Hardened parts can be reworked. Solid dies vs. sectional dies and "unmachinable" vs. machinable are no longer deterrent questions in manufacturing or design.

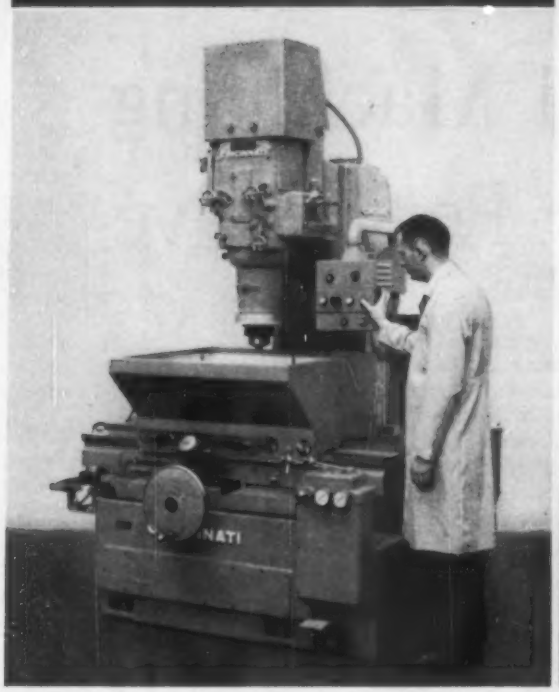
Electrical machining can reduce direct and indirect costs . . . reduce lead time . . . provide a new approach to product design, heretofore limited by conventional metalworking methods.

Electrical machining processes are often placed in the position of competing with each other. However, only one will offer the best solution, and persons qualified to decide should be versed not only in electrical machining, but in conventional methods as well.

A review of the three types of electrical machining, briefly discussed on the two pages following, will assist you in a better understanding of their potential and resulting benefits . . . Milling Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio

CINCINNATI offers you 3 types

ELECTRICAL DISCHARGE MACHINES



CINCINNATI Electrical Discharge Machine — one of 32 sizes and styles built to handle a wide variety of parts. Left: copper anode for an electron tube, in which slots were electrical discharge machined in outer wall.

ELECTROLYTIC GRINDING MACHINES

CINCINNATI Electrolytic Grinding Machine — for "grinding" carbide tools and small parts like the needles at the left, which cannot tolerate burrs or metal smear.

CINCINNATI

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# of electrical machining equipment . . .

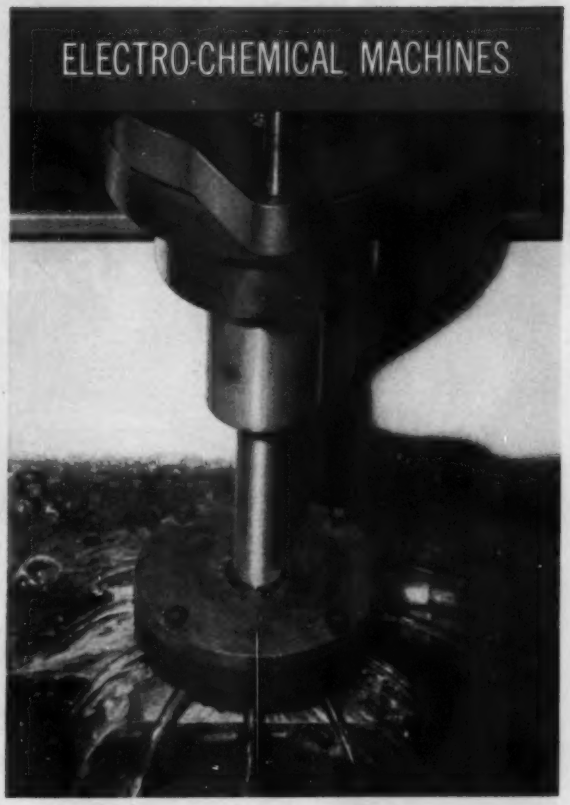
There are three general classifications of electrical machining, each having particular advantages that solve production problems across the complete field of metalworking. Cincinnati Milling builds equipment for all three, and is prepared to show you the potential for widening design horizons and reducing costs in your shop.

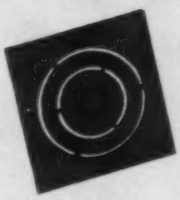
1. *CINCINNATI Electrical Discharge Machines* greatly extend the abilities of the EDM process. Applications include forming, piercing and die sinking on any electrically conductive material, regardless of its hardness and fragility, or unusual geometry of the operation. Cincinnati builds 32 basic EDM machines.

2. *CINCINNATI Electrolytic Grinding Machines* handle a wide variety of general-purpose and cutter and tool grinding applications, offering substantial savings in grinding wheel costs and in grinding time on carbide cutters. Electrolytic grinding produces a burr-free surface that is metallurgically undisturbed. Metals that are ordinarily hard to machine or subject to thermal damage can be handled easily and safely because of the "cold machining" nature of the process.

3. *CINCINNATI Electro-Chemical Machines,* for vertical feed, through-hole production applications in hard-to-machine metals. ECM leaves a burr-free surface with no thermal change, opens new areas of cost reduction.

Which Electrical Machining Process is best for you? Cincinnati has the knowledge and experience to apply the right process to solve your particular machining problem. We will appreciate the opportunity to tell you more.





CINCINNATI Electro-Chemical Process—used to machine narrow circumferential slots through tough steel.

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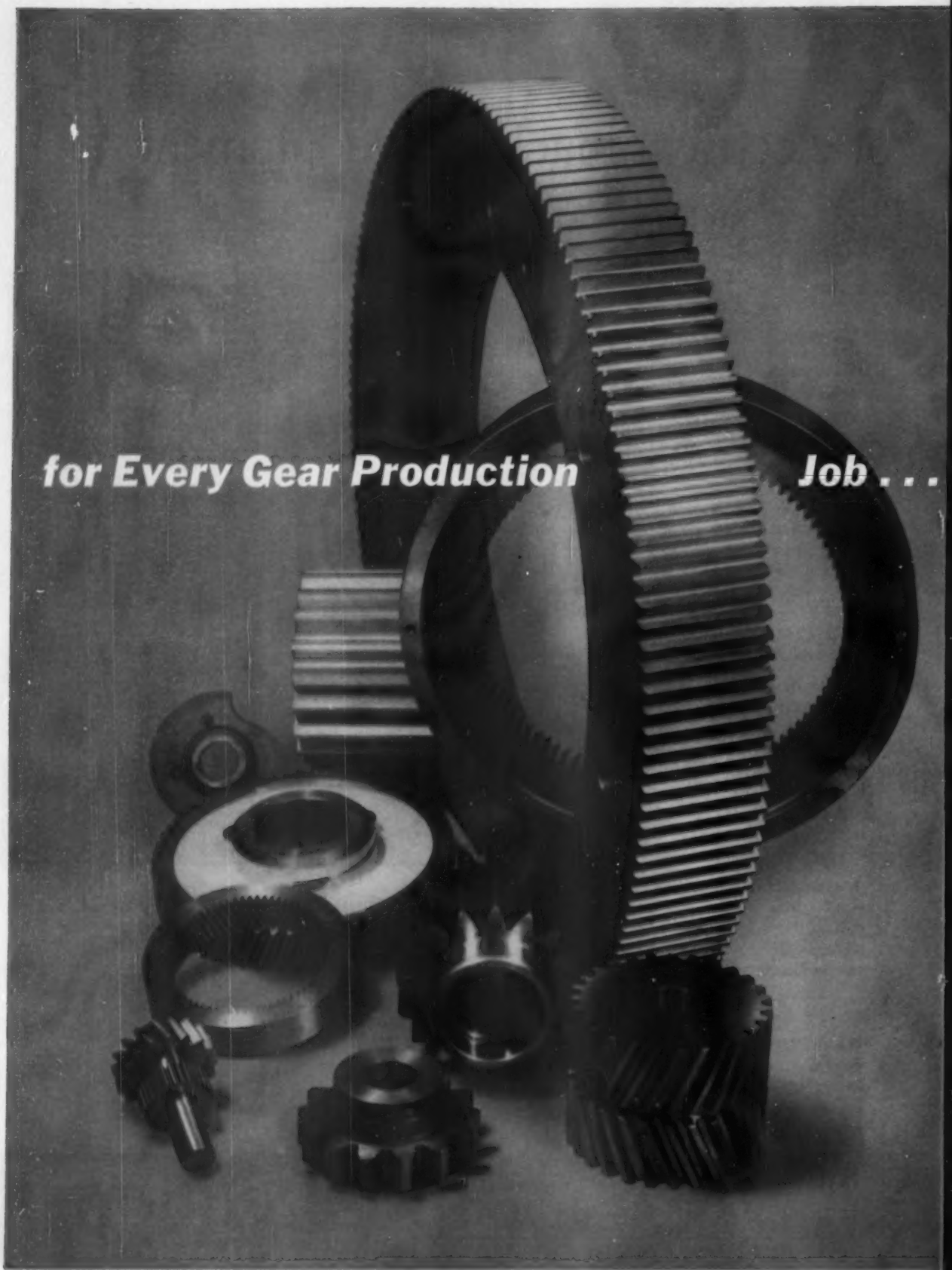
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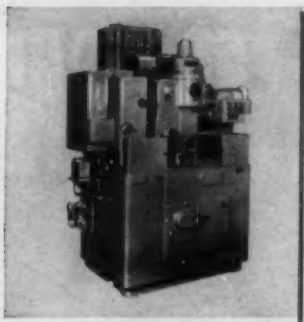
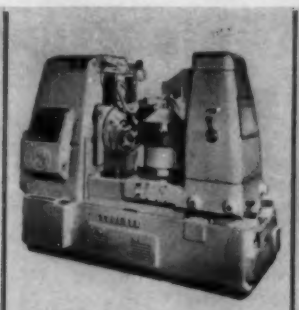
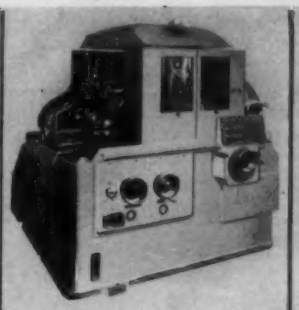


Fellows Gear Shapers cut internal and external spurs and helicals; capacities to 120" P.D.



Pfauter Gear Hobbing Machines for spur and helical gears; capacities to 120" P.D.



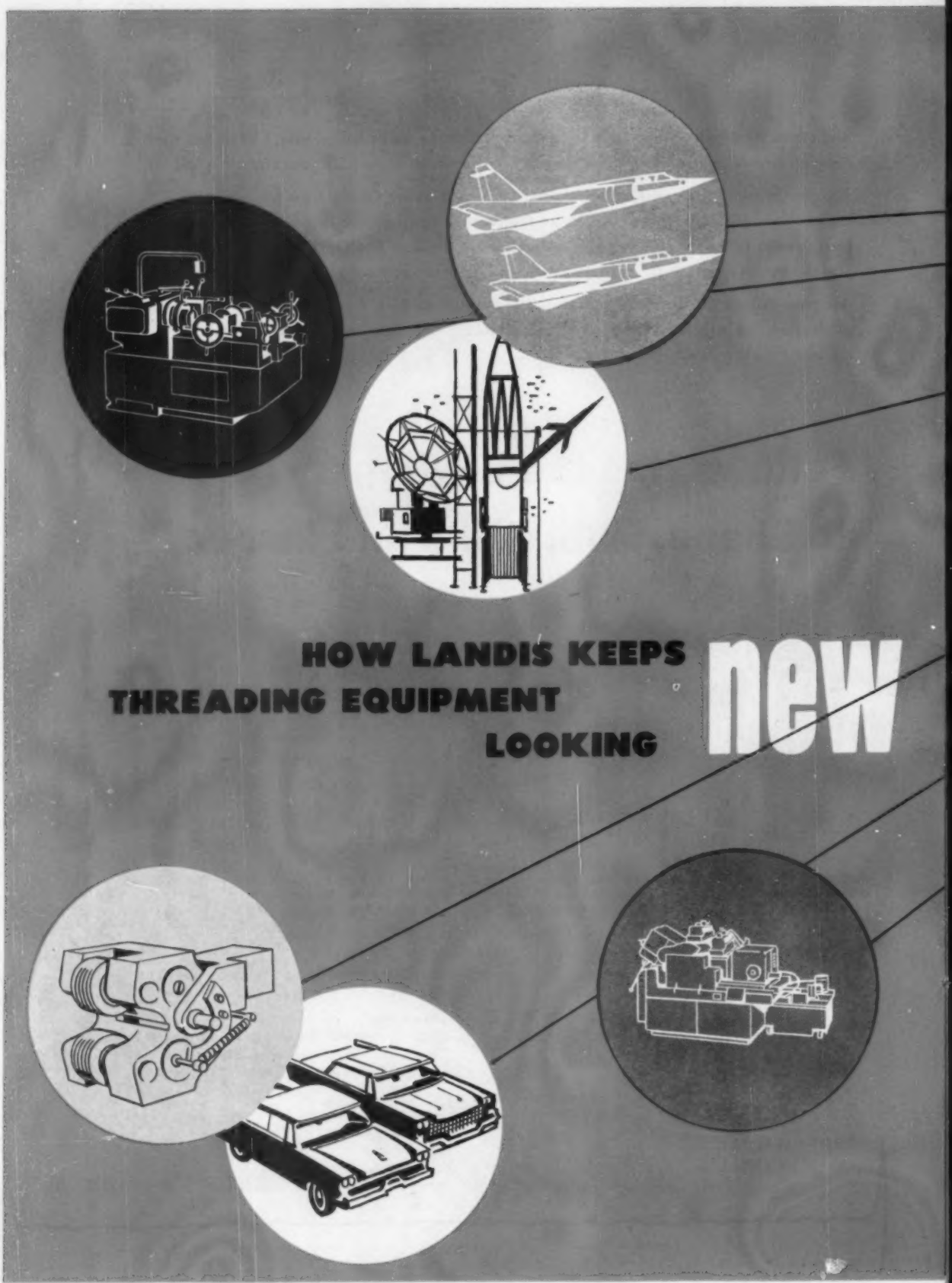
No. 12 Fellows-Reishauer Gear Grinding Machines grind spurs and helicals to 12" O.D.

No. 20M Fellows Red Liners make and record the "composite check" of spur and helical gears to 18" P.D.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont

Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE *Fellows* *Gear Production Equipment*


HOW LANDIS KEEPS
THREADING EQUIPMENT
LOOKING
new

Through the advance thinking of LANDIS research and development new threading equipment is constantly being introduced . . . improved to do the job faster, easier and at less cost.

LANDIS has within the last several years produced many new developments . . . the LANROLL Thread Rolling Attachment . . . the LANHYROL Thread Rolling Machine . . . the LANDMACO C-Type Threading Machines . . . Taper Thread Rolling with the LANROLL Attachment . . . the Automatic Coupling Tapping Machine . . . Thread Rolling Heads . . . and even now new products are on the drawing boards and the testing floors. Recently released was our new production type high speed LAN-NU-ROL Thread Rolling Machine. Each of these machines and tools was designed to improve a specific threading operation. For example, new sizes and types of Die Heads and Collapsible Taps now available are suitable for many jobs that in the past could not be threaded by this equipment.

These new additions to our line emphasize our policy to continue product expansion whenever a need exists. Today, we offer the most extensive line of threading equipment available anywhere. Perhaps one of your threading jobs could be done more efficiently with a modern machine or tool developed from our half-century experience in a single field—THREADING. For detailed information, please send specifications and describe type of operation.

LANDIS *Machine* COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

Threading Machines

Die Heads—Rotary & Stationary

Taps—Collapsible & Solid Adjustable

Centerless Thread Grinding Machines

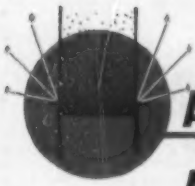
Thread Rolling Tools

Thread Rolling Machines

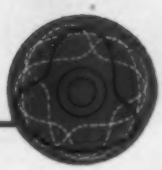
538C

THE BIGGEST in grinding

outstanding allNEW features

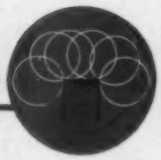


AUTOMATIC INDEXING "ON THE FLY"

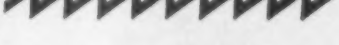


AUTOMATIC LOCATING AND SPARK SPLIT

AUTOMATIC ROTARY DIAMOND WHEEL DRESSING



AUTOMATIC MICROFEED



plus automatic sizing, workrest, loading, unloading

NOW...
A COMPLETELY AUTOMATIC INDEXING CRANK GRINDER

at the MTE
Landis Booth 823

NEWS
automation

LANDIS
world leader in precision grinders

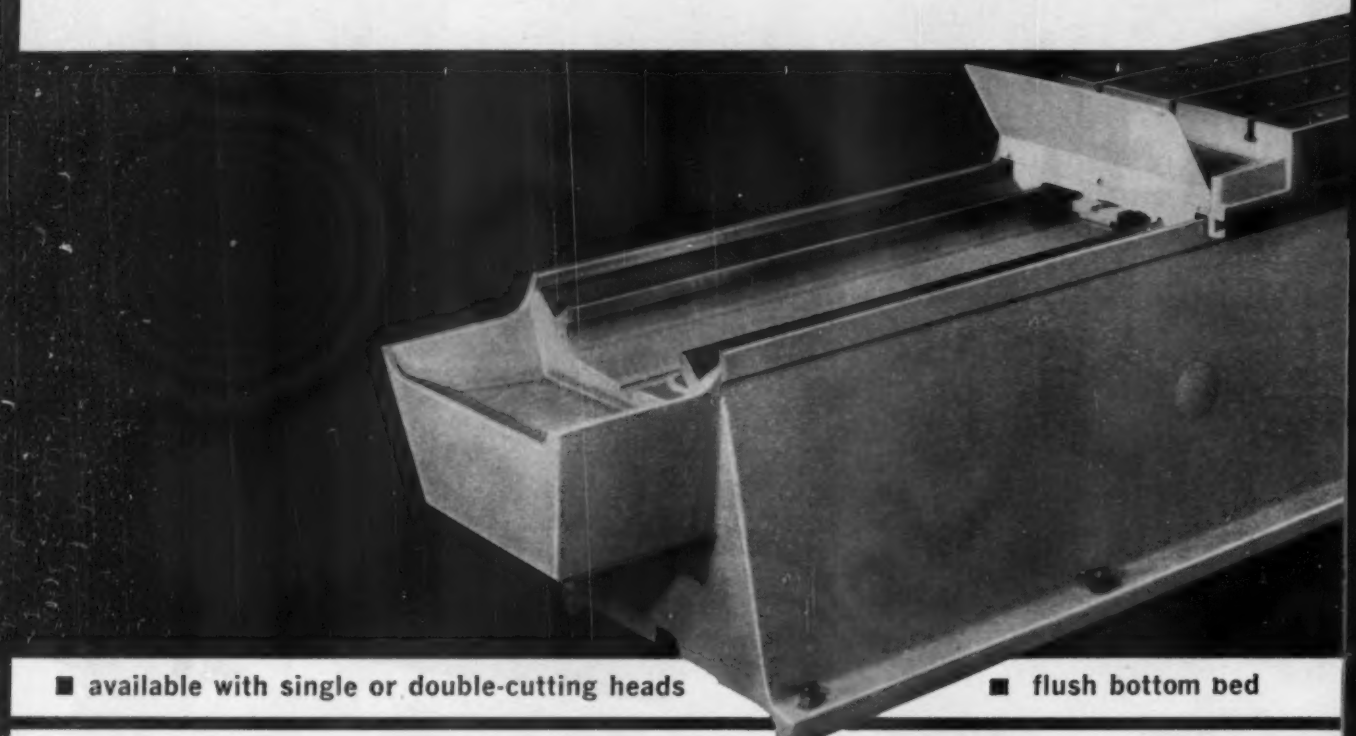
Landis Tool Company, Waynesboro, Pennsylvania

imagine

buying a **GRAY** planer for only

$30,660

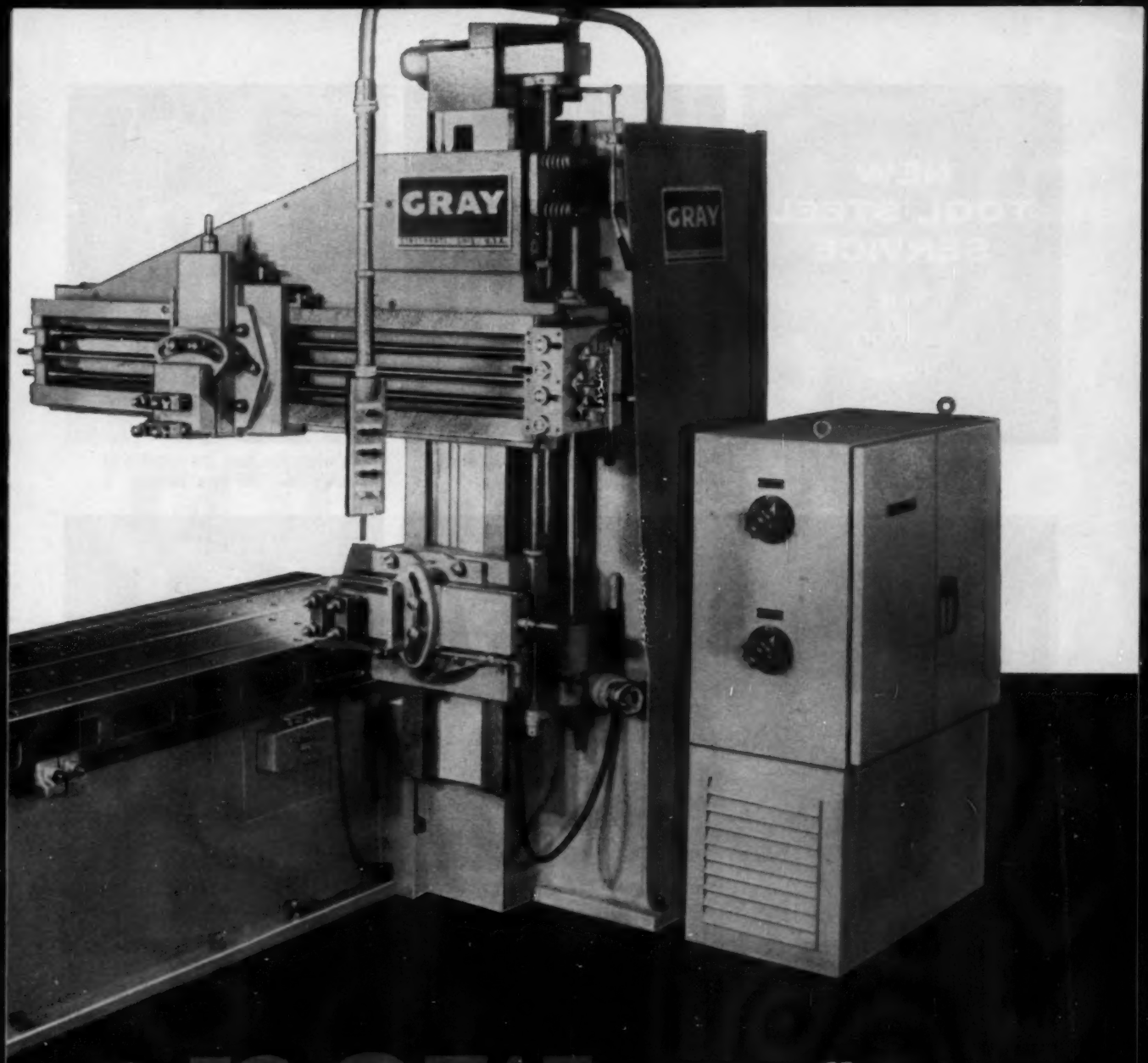
above basic price includes 30" x 6' planer, one rail head, electric drive and controls



- available with single or double-cutting heads
- flush bottom bed
- new Gray knee
- synchro-mesh table replacer
- full pendant control of table
- Gray Safety nut
- full floating drive shaft
- quick acting saddle and slide clamps
- abutment tool aprons
- non-shock pneumatic tool lifters
- infinite feed range

technical bulletin available

CIRCLE 163 READER SERVICE CARD



the new 30"-36"-42" flying scot

■ square locked throughout ■ knee and rail counterbalance ■ pyramid side walls on bed

■ vee ways ■ gray non-metallic ways—optional ■ maximum capacity—table width

■ 'reservoil' lubrication ■ high table speeds ■ duplex tables optional ■ new column

■ helicone transmission ■ space saver drive ■ table safety stop ■ forced lubrication

horizontal milling and boring machines
planers
planer type milling machines

THE G. A. GRAY CO.
CINCINNATI, OHIO

CIRCLE 164 READER SERVICE CARD

NEW TOOL STEEL SERVICE

cuts
inventory
costs

Using too many grades of tool steel can lead to over-stocking—

that's when you need the benefits of Crucible's new Tool Steel Service!

A Crucible Service Engineer can prove that buying a few basic grades—

in quantity—enables you to carry fewer pounds in stock . . .

gives you a lower price per pound (you eliminate small quantity "extras"),

and with fewer grades to identify, you reduce the possibility of "mixed" steel.

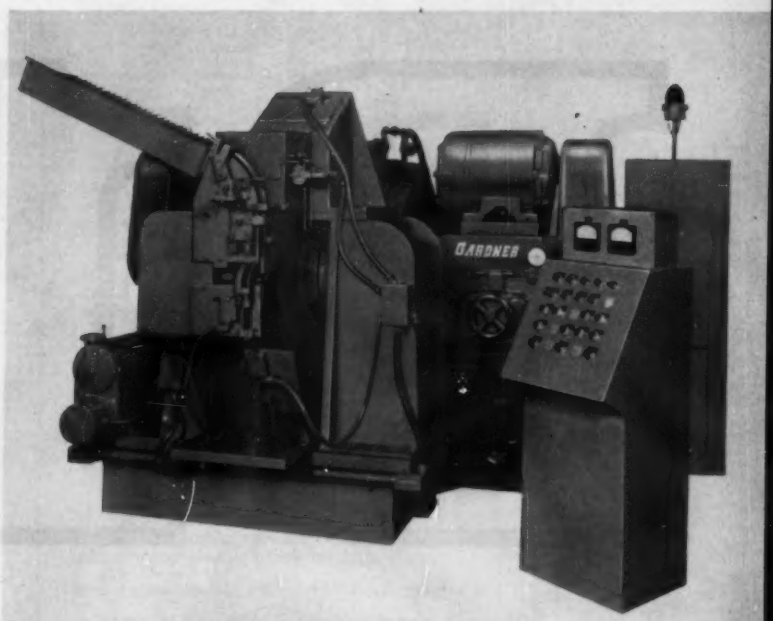
All through standardizing on a few basic steels!

For the full story on this cost-reducing service, call in a Crucible Service Engineer

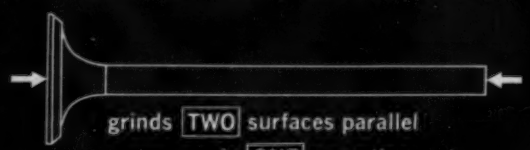
CRUCIBLE STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J. • Charlotte • Chicago • Cincinnati • Cleveland • Columbus • Dallas • Dayton Denver • Detroit • Erie, Pa. • Grand Rapids • Houston • Indianapolis • Los Angeles • Miami • Milwaukee • Minneapolis • New Haven • New York • Philadelphia Pittsburgh • Portland, Ore. • Providence • Rockford • Salt Lake City • San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tulsa
CRUCIBLE STEEL OF CANADA, LTD., SOREL, QUEBEC, CANADA

GRINDS 2200 VALVES PER HOUR



Gardner 2H30 disc grinder with automatic loading, grinding, sizing and unloading cycle.



grinds TWO surfaces parallel in ONE operation

production data

production:	2200 per hour at 100% efficiency
stock removal:	head end .006" max.
	stem end .007" max.
squareness:	head end TIR .003"
	stem end TIR .0003"
uniformity:	TIR .002"
finish:	stem end 12 RMS

MMT PE

GARDNER

precision disc grinders

BELOIT, WISCONSIN

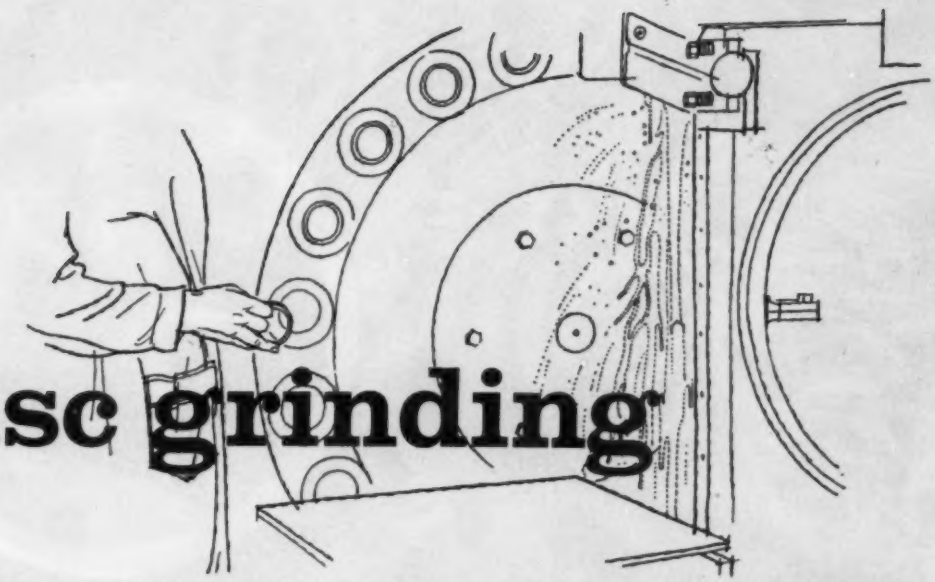
Announcing:

A new high in

set by

B14

New Norton Resinoid Bonded DISCS



disc grinding

Under development and testing for two years . . . now available as the finest discs of their type ever made.

At Norton, product development never ends — either as a policy of leadership or as a continuous source of new advantages to industry in every type of grinding.

The latest news-making achievement in Norton product development is the B14 resinoid bond for disc wheels.

Development of the B14 bond involved not only improvements in bond material but entirely new processing.

It took several years to perfect these changes. It also took many months to complete nationwide testing of the new B14 discs, on all types of disc grinders — horizontal or vertical spindle, single or double — on jobs ranging from snagging to precision finishing, and on ferrous, nonferrous and non-metallic materials. Also, the tests were entirely comparative — not only against competitive wheels but against Norton discs which were then standard.

Results of this across-the-board testing are outstanding. The new B14 discs have proved beyond question their ability to grind more workpieces per disc . . . faster and better, with fewer dressings . . . and with constant uniformity throughout extra long disc life.

Let new B14 discs bring *you* proof of better, lower cost surfacing. Have your Norton Man, a trained Abrasive Engineer, study your requirements and make trial runs of the B14's you need — solid discs or segmental, ALUNDUM* or CRYSTOLON* abrasive. Or get details from your Norton Distributor. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Marks Reg. U.S. Pat. Off. and Foreign Countries

A few of very many reports from Norton customers . . .
PROVING B14 DISCS THE BEST

JOB: Rough grinding iron castings, 3½" x 2½".

REPORT: **B14 37 CRYSTOLON wheel ground 6,000 parts with one dressing. Best previous disc gave 4,500 parts with 4 dressings.**

JOB: Surfacing cold rolled steel washers on double disc machine.

REPORT: **B14 19 ALUNDUM discs impressive as best so far, with very even wear.**

JOB: Through-feed grinding of 52,100 steel bearing races.

REPORT: **B14 ALUNDUM disc very free from cutting, clean and cool. Longer life than previously used Norton disc.**

JOB: Double-disc grinding Alnico magnets.

REPORT: **B14 mixed-abrasive wheel thoroughly approved for new orders.**

JOB: Double-disc grinding abrasive sticks.

REPORT: **B14 37 ALUNDUM disc gave improved rate of cut. More abrasive sticks per disc-dressing.**

JOB: Rough grinding miscellaneous parts on double end machine.

REPORT: **B14 44 ALUNDUM disc performed better, lasted longer than all types.**

NORTON
ABRASIVES

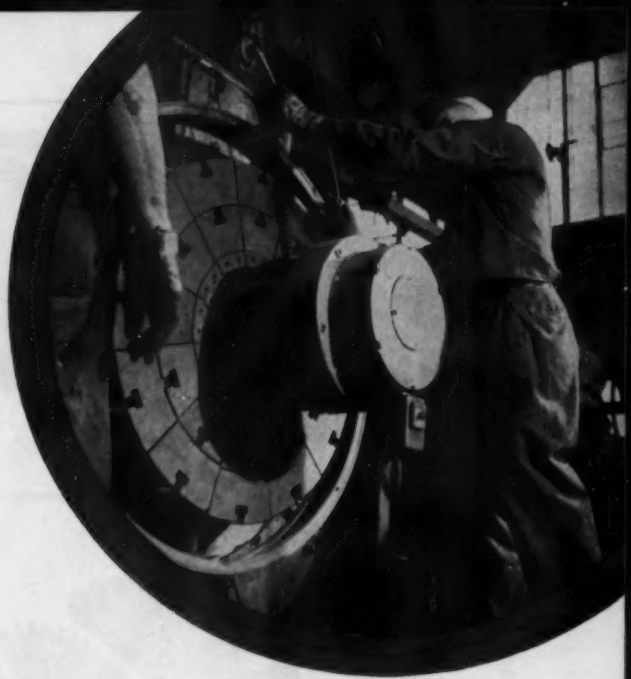
W-1991

75 years of . . . Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

Amweld rings up $14,621

On 8 ring-sizing machines Amweld was experiencing hydraulic difficulties similar to those in the butt welding units. Oil deposits, sticking valves, pump failures, etc. were common problems. 1040 maintenance man-hours a year were required to keep the equipment operating. But again the introduction of a Mobil hydraulic oil and preventive maintenance procedures slashed this labor cost, saved Amweld $2,005 the first year.



On three of Amweld's expander units, brass wear plates on the expanding mandrel were undergoing serious wear. Frequent replacement of these plates, with attendant labor costs, meant a $3,936 expenditure for Amweld in one year alone. Studying the problem, Mobil Engineers recommended an extreme pressure grease. In the year since this Mobil product was introduced, not a single replacement has been made.

savings with Mobil!

A leading producer of welded rings, American Welding & Manufacturing Co. cuts maintenance costs with Mobil Lubricants and engineering service.

Specializing in the production of welded rings, bands and assemblies, American Welding has developed methods and techniques for precision-welding alloy steels and non-ferrous materials in both light gauges and heavy sections. Parts are supplied "as-welded," or machined and finished, to prime contractors, and include components for jet engines and missiles.

Critical tolerance requirements demand rigid maintenance procedures at Amweld. And Mobil products and engineering service have made significant contributions in terms of minimized machine downtime and consistent savings in lubricant and parts costs. Working in close cooperation with Amweld technical personnel, Mobil has made recommendations that have saved this producer $14,621.

Mobil's extensive background in lubrication may help you achieve similar savings in your plant. Your Mobil Representative is the man who can tell you.

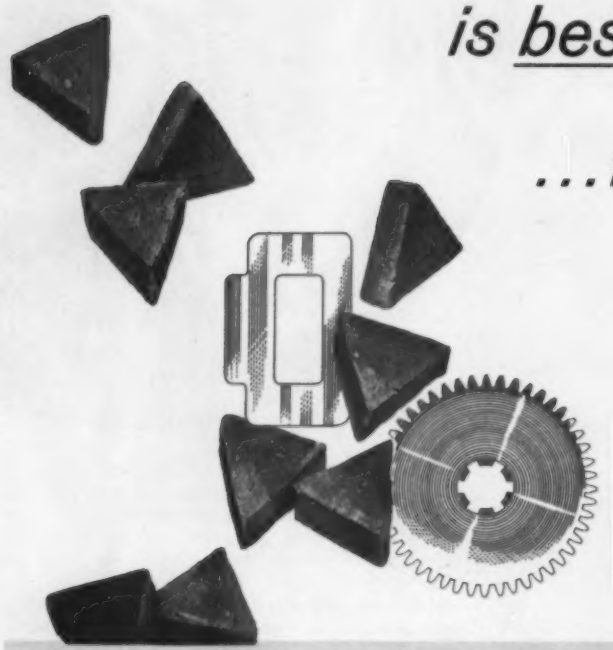
Mobil

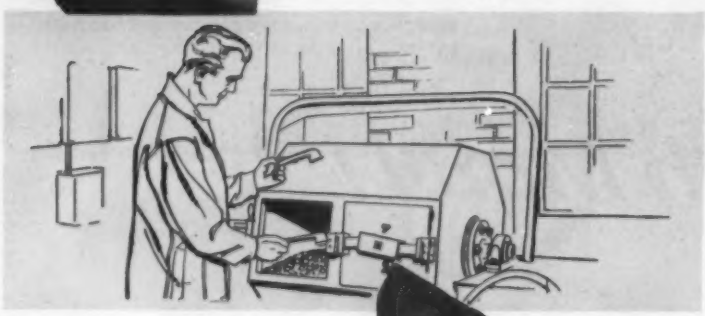
CORRECT LUBRICATION

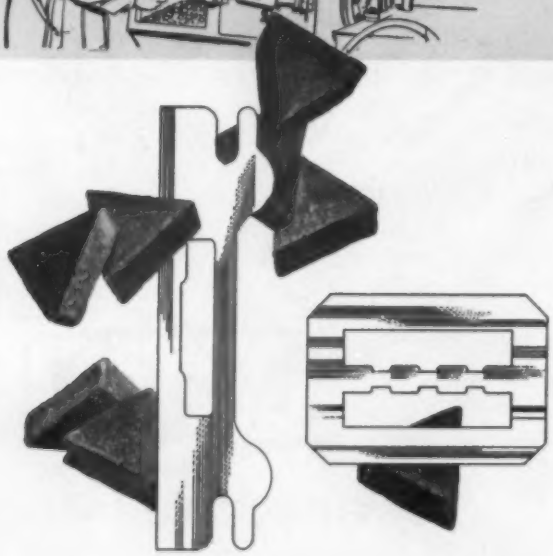
MOBIL OIL COMPANY, 150 E. 42nd St., New York 17, N.Y.

Barrel finishing is best finishing

. . . for many jobs use TUMBLEX "T"*







Don't let old-fashioned hand-finishing waste your production time and money.

Cut your cost-per-piece-produced by choosing the right barrel finishing equipment.

Cut this cost to very lowest by choosing the right Norton TUMBLEX *abrasive . . . available in five types and many sizes . . . engineered for best results covering the range of barrel finishing.*

For finishing intricate parts, TUMBLEX "T" abrasive comes in triangular, non-wedging shape. It is made of bonded ALUNDUM* abrasive, assuring "Touch of Gold" performance that includes long, even wear; fine, uniform finish; short time cycles and sure savings.

Send samples of parts you finish to our Sample Processing Department. We'll barrel finish, return samples, and report the methods and abrasive you need to improve quality and cut costs. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES

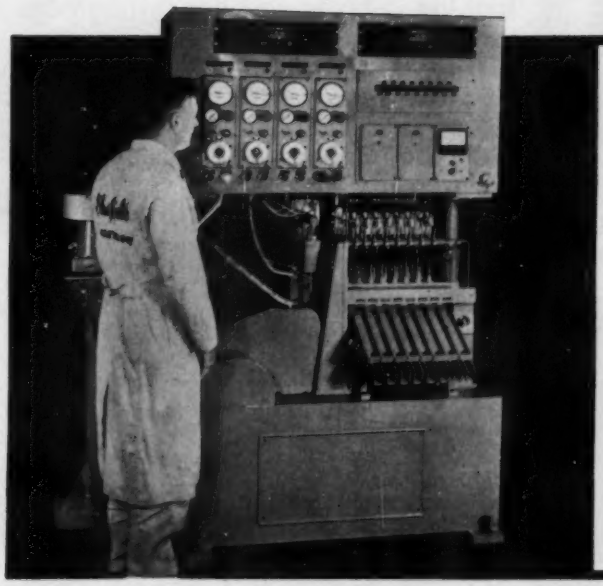
C-392

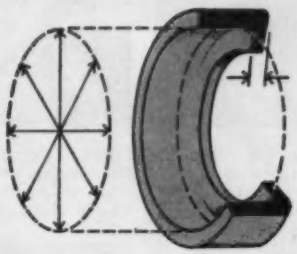
75 years of . . . Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — BEAR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

See the whole Sheffield line in action at Booth 201

Machine Tool Show near main entrance





*This Sheffield automatic gaging, classifying and segregating machine inspects up to 2,000 rings an hour for the Western Electric Company. It simultaneously measures inside diameter and flange thickness, classifies rings into 15 sizes plus out of tolerance, and rejects each size in its chute. Its speed and accuracy have resulted in appreciable manufacturing savings.

A Sheffield sorter* sorts 2000 rings an hour

One of them is in your telephone.

Pick it up and call SHEFFIELD for further information on automatic gaging and assembly machines. CL 4-5377, Ext. 211, 212, 213.

The SHEFFIELD Corporation Dayton 1, Ohio

A subsidiary of the Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.

Metallurgical Memo from General Electric

General Electric announces pre-honed CARBOLOY® inserts

Hand-honing is inaccurate, and time-consuming—frequently results in premature chipping and breaking.

Chamfered, or ground-flat, edges are geometrically weaker than a radius and are more easily chipped or broken.

Unhoned or as-ground inserts show rough edges—result in unpredictable tool life due to chipping.

Shown here, both under magnification and graphically, is an edge of the new Carboloy pre-honed insert. Radius is geometrically ideal to minimize chipping, extend tool life many times.

Now you get more predictable tool life... lower cost per cutting edge ...no hand-honing cost!

Ready-to-use... honed to a precise radius... promise BETTER PROFITS THROUGH BETTER TOOLING

Now General Electric Carboloy inserts are pre-honed *at the factory!* Here's what it means to you:

1. An insert with edges honed to precise *radii* gives the strongest geometric shape to withstand cutting pressures. This reduces chipping – increases the predictability of tool life. Hand honing *cannot* achieve precise radii – G-E pre-honing can . . . and does!

2. Since chipping is minimized, fewer cutting edges are wasted. The result is lower cost per cutting edge.

3. Since inserts come pre-honed and ready-to-use, the labor cost of hand honing is eliminated. This more than offsets the charge for pre-honing.

4. Pre-honed Carboloy cemented carbide inserts have standard edge radii honed to a greater or lesser degree, depending on the job to be done. You'll *know* the honing is right!

Ask your Authorized Carboloy Distributor about pre-honed Carboloy inserts, convertible seats, toolholders, and brazed tools. Or, write: *Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Street, Detroit 32, Michigan.*

TOPS IN TOOLING QUALITY

From the research and quality-control facilities of the Metallurgical Products Department of General Electric comes the outstanding quality tooling line in the metalworking industry. The new Carboloy pre-honed inserts, as well as the complete line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling, are designed to meet every tooling need efficiently and economically.

CARBOLOY®
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

NEW MORSE TOOL FILLS 4 JOBS AT AAF

Reams, bores, finishes and faces both ends of mandrels—in one fast, automatic operation. Savings: $24,000 a year.

When engineers at American Air Filter and Morse got their heads together on a cutting tool problem, the result was a *six-times-faster* turnout of spool mandrels.

AAF designed the machine; Morse created the tool. And for more than a year now, AAF mandrels have been getting the four-power Morse treatment—reaming, boring, finishing, facing. Quality on spec . . . costs 'way down.

Morse tools are tough, cut smooth and fast, give production schedules a new lease on life. Why not find out for yourself? Call your Morse-Franchised Distributor . . . the man with the facts.

MORSE

means "THE MOST" *in Cutting Tools*

MORSE TWIST DRILL & MACHINE CO., NEW BEDFORD, MASSACHUSETTS

Warehouses in: NEW YORK • CHICAGO • DETROIT • DALLAS • SAN FRANCISCO

CIRCLE 174 READER SERVICE CARD

Morse means more production . . . smoother, more accurate production . . . with every type of cutting tool from drills, reamers, taps and dies, to end mills, milling cutters, slitting saws and "specials". So, if you want the best from every cutting tool you buy, mark your order "MORSE". For if you want *Morse Quality*, there's only one way to get it . . . *specify Morse.*

VN

A Division of VAN NORMAN INDUSTRIES, INC.

THESE 13 SPECIAL ALLOYS FROM *can help you solve design problems . . .*

As the result of the knowledge gained over the years by working closely with hundreds of customers in helping solve innumerable design and production problems, the Mueller Brass Co. has developed a series of special alloys for use in tough or unusual applications.

This group of special alloys, each having distinct characteristics and advantages, are available in rod form in many sizes and shapes as well as forgings.

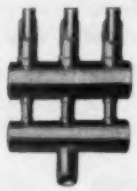
CHARACTERISTICS AND APPLICATIONS	ALLOY NO.	NAME	TEMPER
TUF-STUF® ALUMINUM BRONZES AND NICKEL ALUMINUM BRONZES have great strength characteristics. All are more resistant to corrosion cracking under load than copper-zinc alloys and, in addition, some are heat-treatable. They can withstand heavy pounding and have proved excellent for such parts as gibs, cams, valve seat inserts, shifting forks and propeller hub cones.	224E-30	"Tuf-Stuf" Aluminum Bronze	BRINELL 1000 KG load 165
	224E-75	"Tuf-Stuf" Aluminum Bronze	BRINELL 1000 KG load 175
	224C	"Tuf-Stuf" Aluminum Bronze	BRINELL 1000 KG load 185
	224H	"Tuf-Stuf" Aluminum Bronze	BRINELL 1000 KG load 200
	224K	"Tuf-Stuf" Nickel Aluminum Bronze	BRINELL 3000 KG load 250
ALUMINUM SILICON BRONZE is free turning; has high strength, is corrosion resistant and non-magnetic and resistant to corrosion cracking under load.	802	Aluminum Silicon Bronze	ROCKWELL-B 75
600 SERIES® FORGEABLE BEARING ALLOYS range from high strength to low loaded ductile. All are corrosion resistant, free cutting, can be used with hard or soft mating members and can be soldered. They are employed in a great variety of applications ranging from pump gears and valve stems to pinion shafts and transmission rings.	600	Forgeable Bearing Alloy	ROCKWELL-B 88
	601	Forgeable Bearing Alloy	ROCKWELL-B 87
	602	Leaded Forgeable Bearing Alloy	ROCKWELL-B 87
	604	High Leaded Forgeable Bearing Alloy	ROCKWELL-B 86
	605	Low Leaded Forgeable Bearing Alloy	ROCKWELL-B 80
MANGANESE BRONZE ALLOYS are exceptionally strong, tough, resistant to shock and corrosion. Good for screw machine products and forgings for aircraft parts.	241A	Manganese Bronze A	ROCKWELL-B 85
	721	Manganese Bronze High Tensile Grade B	BRINELL 1000 KG load 200
TELLURIUM COPPER has very high electrical and thermal conductivity combined with good corrosion resistance and machinability. Excellent for electronic components.	799	Tellurium Copper	ROCKWELL-B 45

NOTE: The values shown are average values normally obtained in production. Variations must be expected in practice. The values should be used as a general guide rather than the basis for specifications.

ONE DEPENDABLE SOURCE FOR

COLD-PREST® IMPACT EXTRUSIONS

SINTEEL® POWDERED METAL PARTS



FORMED COPPER TUBE

MUELLER BRASS CO.

THE MUELLER BRASS CO.

lower costs and improve your products

Mueller Brass Co. engineers and metallurgists are always ready to assist in the selection of the proper alloy for your particular product.

Regardless of your responsibility... design, specification, production or purchasing... Mueller Brass Co. special alloys can help you lower costs and improve your products. Call the "Man From Mueller Brass Co." today and put these remarkable alloys to work on your toughest jobs.

Yield Strength at 0.5% Extension Lbs./Sq. In.	Tensile Strength Lbs./Sq. In.	Relative Machinability Free Cutting Brass=100%
50,000	82,000	30
65,000	100,000	30
62,000	95,000	35
70,000	90,000	30
65,000	105,000	20
35,000	85,000	60
60,000	90,000	25
55,000	78,000	35
65,000	85,000	65
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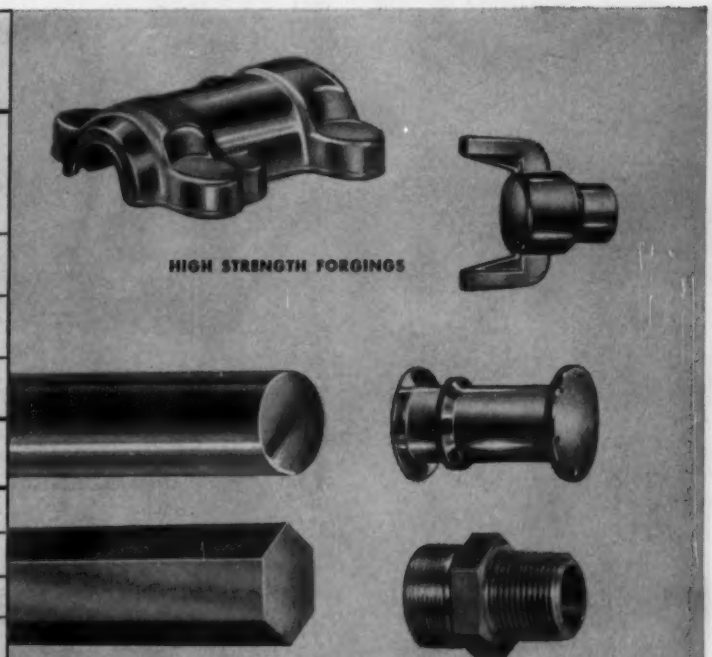
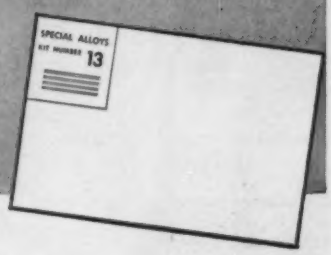
45,000	70,000	55
55,000	78,000	25
68,000	115,000	35
40,000	43,000	90



HIGH STRENGTH FORGINGS

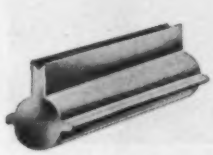
ROD SHAPES FOR SCREW MACHINE PRODUCTS

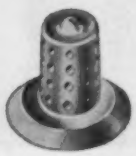
For further information on these alloys write today for Special Alloys Kit No. 13. Engineering information on other fabricated products is also available . . . please specify the manual you desire.



ALL THESE QUALITY PRODUCTS

SAND CASTINGS





CUSTOM EXTRUDED PLASTIC SHAPES AND INJECTION MOLDINGS

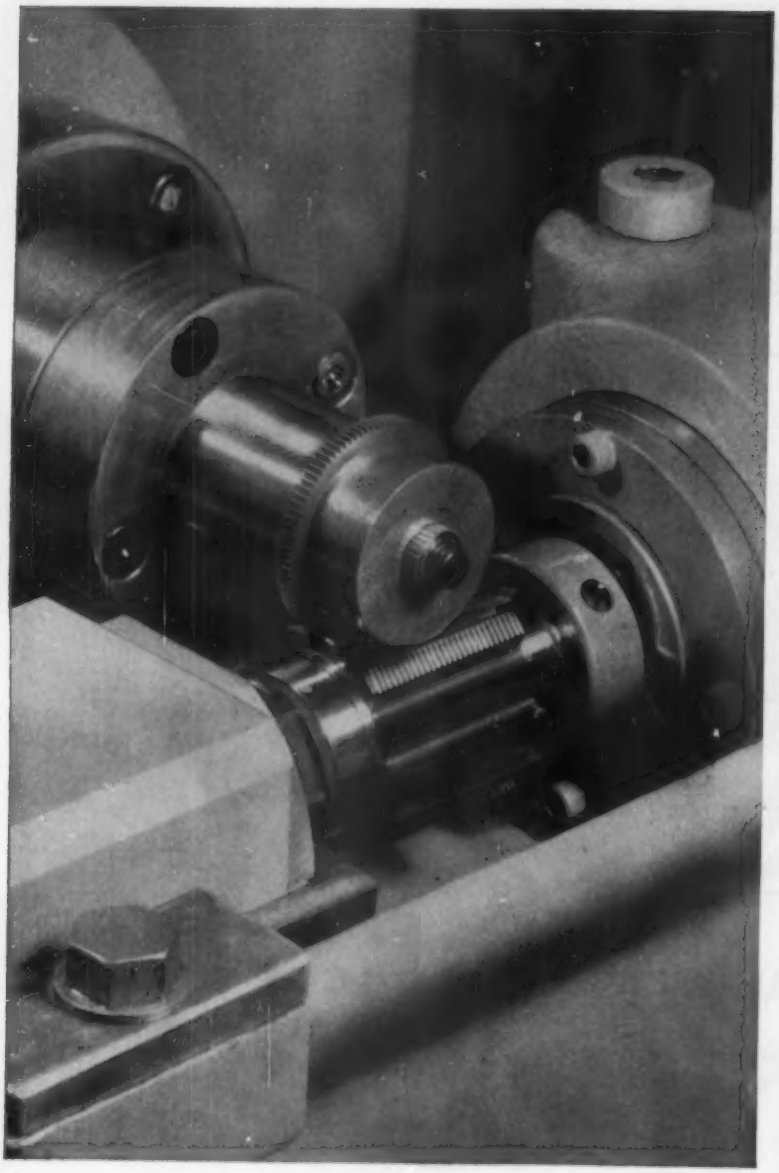
MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

PORT HURON 24, MICHIGAN

301

New method of producing

AGMA Precision



Selection and segregation no longer necessary to insure precision-matched spur gear sets

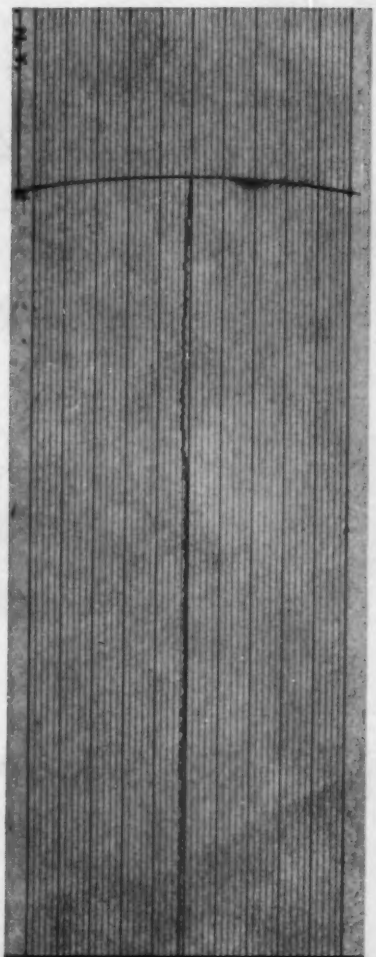
Selection and segregation — the process of producing more gears than you need in order to select a few that are within Precision Class 2 or Class 3 tolerances — is no longer necessary. And, these jobs at PIC Design Corporation, East Rockaway, L.I., New York, prove it.

In pioneering "Ultracision" accuracy for the missiles industry, Barber-Colman Company developed extensive machining and testing techniques now embodied in a new, low-cost hobbing machine — the No. 2½-4. For mass production of easily machinable parts which do not require such a high degree of accuracy, a high-speed version of this machine is available with a maximum hob speed of 2400 rpm.

Completely new hobbing machine

New concepts have been introduced into the Barber-Colman No. 2½-4 to bring you exceptional accuracy at a nominal cost. The No. 2½-4 is guaranteed to index accurately within 20 seconds of arc. This means that nonadjacent spacing error on a 2" dia. gear would be only .0001" due solely to the indexing error of the machine. When rigid tooling . . . accurate blanks . . . care in mounting the hob and work . . . Class AA hobs . . . and accurate hob-sharpening methods are used, it should be possible to hob AGMA Precision Class 2 and Class 3 gears without selection and segregation. Scrap and inspection time are reduced. And, in many

Class 3 Gears



Each line on tape represents .0001". This Precision Class 3 gear was obtained with only slightly more care than required for Class 2 gears.

cases, deeper savings can result from the elimination of finishing operations.

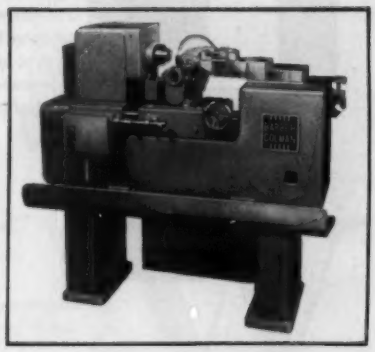
The accompanying PIC "true blue" gear tape shows the inspection record of a Precision Class 3 gear. On the production run, all gears had a total composite error of less than .0004". The gears have 96 teeth of 64 DP. The tape is made on a variable center-distance checking machine with a motor-driven master gear which rolls under preset pressure with the cut gear. After the work spindle adapter and the hob were trued within .0001", no further adjustments were necessary for hobbing gears of this accuracy.

The No. 2½-4 accommodates 3" dia. hobs, permitting maximum number of flutes for cutting accurate, smooth tooth profiles. Maximum work diameter is 2½" and length of cut is 2¼" — for steel gears as coarse as 30 pitch or brass up to 20 pitch.

PIC pursues accuracy in every corner of production

As you examine the results being achieved with the No. 2½-4 by PIC Design Corporation, you will see that in their pursuit of predictability and precision, no stone is left unturned.

Bores of Precision Class 2 and 3 gear blanks are machined to +.0002", -.0000" for size and roundness. Before turning, blanks are mounted on arbors the same size as the bores, with a .0002" taper. They are inspected for face wobble and must run true within .0002" per inch of diameter before the OD's are turned to a concentricity tolerance of .0001". This operation is checked at two points, 180 deg. apart.



In hobbing, the arbors are held in a floating adapter which permits fine adjustment to desired concentricity. PIC uses only Barber-Colman Class A or AA hobs, trued on the machine to less than .0001" runout.

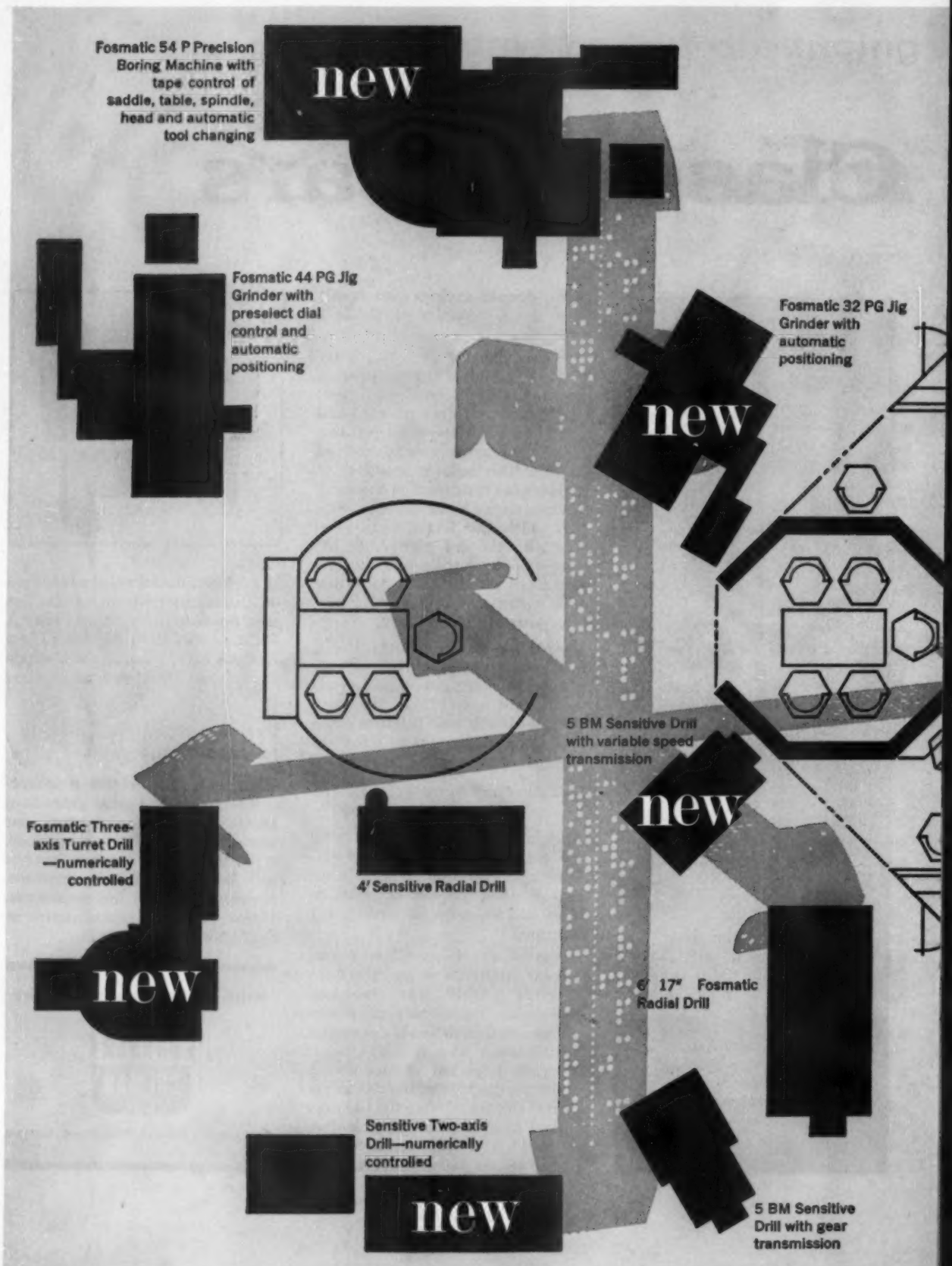
Evaluate your gear processing and costs

If you have the problem of producing precision fine-pitch gears at a profit or want to improve your product by increasing gear accuracy, a Barber-Colman process analyst will help you evaluate methods, tooling, and cost improvements. Phone your B-C representative or the factory — WO 8-6833.

Barber-Colman Company

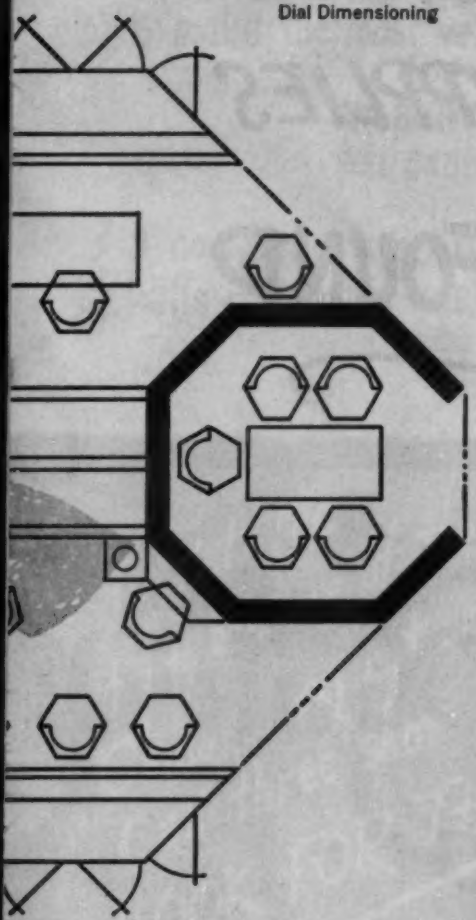
BARBER COLMAN

81 Loomis Street, Rockford, Illinois


Fosmatic 54 P Precision Boring Machine with tape control of saddle, table, spindle, head and automatic tool changing
new
Fosmatic 44 PG Jig Grinder with preselect dial control and automatic positioning
Fosmatic 32 PG Jig Grinder with automatic positioning
new
5 BM Sensitive Drill with variable speed transmission
new
Fosmatic Three-axis Turret Drill —numerically controlled
new
4' Sensitive Radial Drill
6' 17" Fosmatic Radial Drill
Sensitive Two-axis Drill—numerically controlled
new
5 BM Sensitive Drill with gear transmission

new

Fosmatic 42 P Jig Borer with Direct Dial Dimensioning



See Fosdick in action at the Machine Tool Exposition, Chicago, September 6-16.

MMT-PE

new at the show

BOOTH 800

Rest your tired production worries here.

Chasing that elusive last ten-thousandth inch? Here are machines guaranteed to work to that 4th decimal place *on a production basis.* Now Fosmatic Precision Boring Machines are completely automatic, with numerically controlled saddle, table, spindle, head, and tool changer. This is NEW. See them at The Show. Booth 800.

Now famous Moore-Fosdick Jig Grinders have automatic positioning and numerical control. This is NEW. See them at The Show. Booth 800.

Now Fosdick has Numerically Controlled Drilling Machines, versatile and fast. Here's an end to a frozen investment in drill jigs and fixtures. They're NEW. See one at The Show. Booth 800.

Drilling speed like you never saw before, with a battery of tools at the command of a button. It's yours with Fosdick's brand NEW Turret Drill. See it in Booth 800.

And that isn't all that's new. Come to booth 800 and see for yourself.

Get a proposal from Fosdick.

FOSDICK THE FOSDICK MACHINE TOOL COMPANY
Cincinnati 23, Ohio

YOUR BEST GUIDE TO
1960's RECORD BREAKING EXHIBITS
OF METALWORKING'S
EQUIPMENT AND SUPPLIES

WILL BE FOUND
IN THE

Chicago Exposition Issue

of American Machinist / Metalworking Manufacturing

a 200-page advance look at the Machine Tool Exposition, Production Engineering Show and Coliseum Machinery Show

authoritative descriptions of "WHAT'S NEW" in equipment, materials and supplies at each of the three expositions

a preview to help you plan your Chicago visit to make the most valuable use of your time

an authoritative reference for the things you examined and discussed during your visit

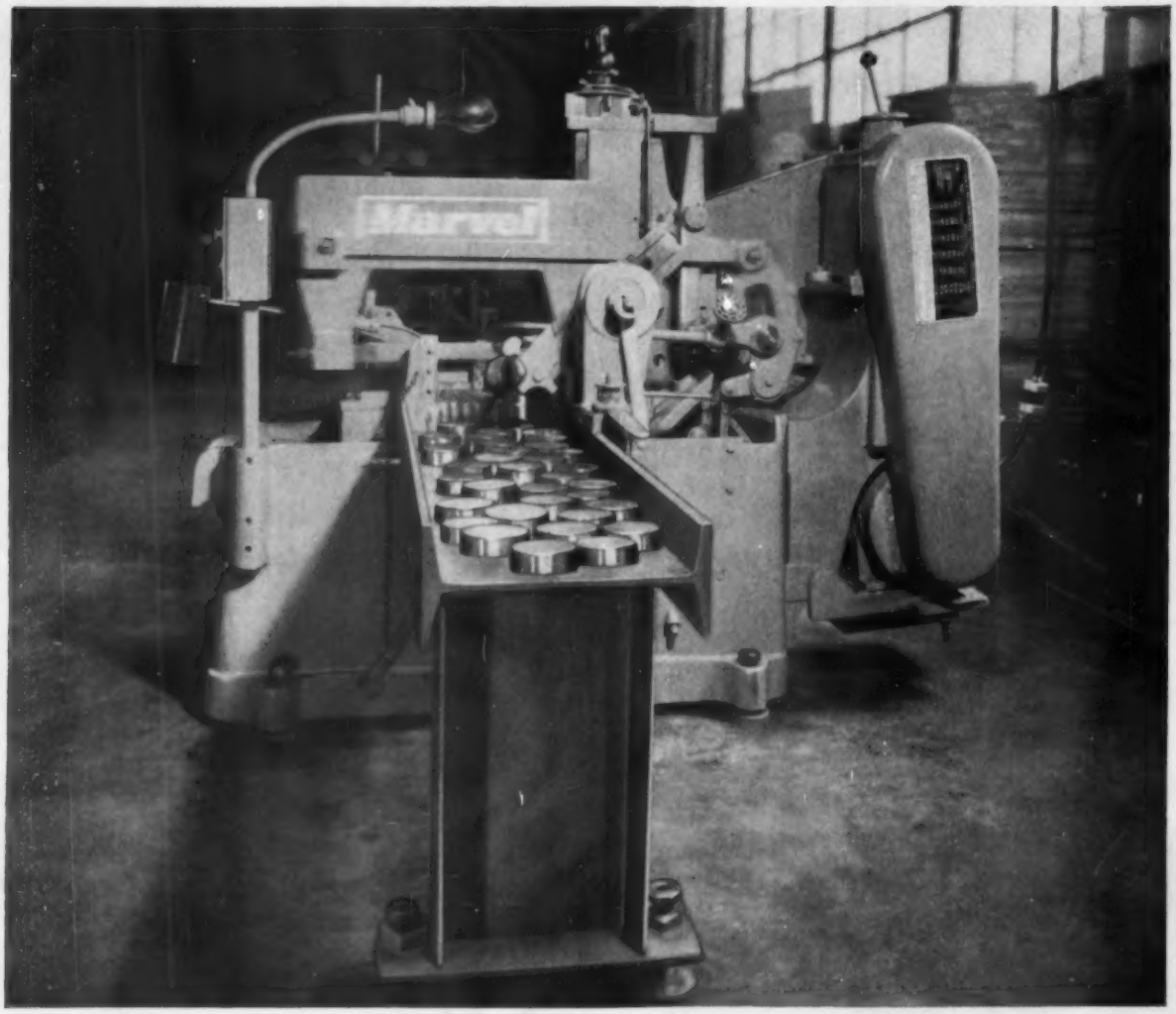
a comprehensive trip through the three exhibit halls if you are unable to attend

To get the full picture of the Chicago exposition (all three shows) LOOK FOR THE

August 22, 1960 Issue of

American Machinist / Metalworking Manufacturing

THE BIGGEST (and most authoritative) ISSUE ON METALWORKING'S BIGGEST SHOW



Payoff End of a Production Marvel

A cut-off saw's value is proven at the discharge end of the machine. How quickly the trough is filled with accurately cut-off pieces can mean the difference between profit and loss on many jobs.

The R. J. Sudrick Co., Des Plaines, Illinois, manufacturers of precision aircraft components had to cut-off 4600 blanks from 3¼" round, 303 Stainless Steel Bars.

They bought our MARVEL No. 6A4 High Speed Heavy Duty Automatic Bar Feed Hack Saw Machine; used MARVEL High-Speed-Edge Hack Saw Blades, and got the high production, accuracy and economy they desired.

PRODUCTION? Constant at 20 pieces per hour floor to floor

ACCURACY? Held well within the permissible tolerance of +.010 —.000

BLADE COST? Just 1½¢ per cut. Only twenty-three MARVEL blades were needed to make the 4600 cuts, and not a single blade failure due to blade breakage. MARVEL High-Speed-Edge Blades are unbreakable.

The point is this: MARVEL Metal Cutting Hack Saws equipped with MARVEL High-Speed-Edge Hack Saw Blades are an unbeatable combination for economical, accurate and safe cutting-off.

If your hack saws are not producing the economy you need to meet today's competition, try MARVEL High-Speed-Edge Blades. They will give you the competitive edge every time. Write for Catalog C-85 which has the complete story on MARVEL Hack Saws and Band Saws, Hack Saw Blades and Band Saw Blades.

MMT-PE

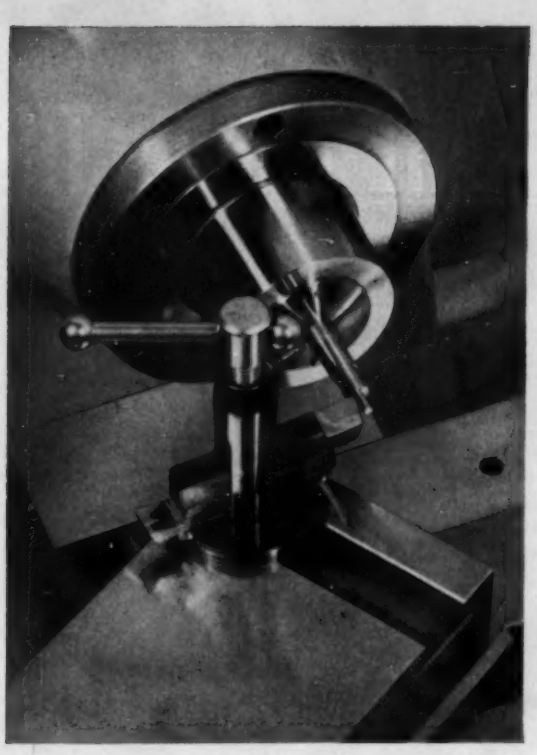
See us in Space 1340
Machine Tool Exposition

ARMSTRONG-BLUM MFG. CO.

5700 W. BLOOMINGDALE AVE., CHICAGO 39, ILL.

MARVEL Metal Cutting SAWS

Better Machines—Better Blades



When

ACCURACY

REALLY COUNTS

SPECIFY:

HARDINGE

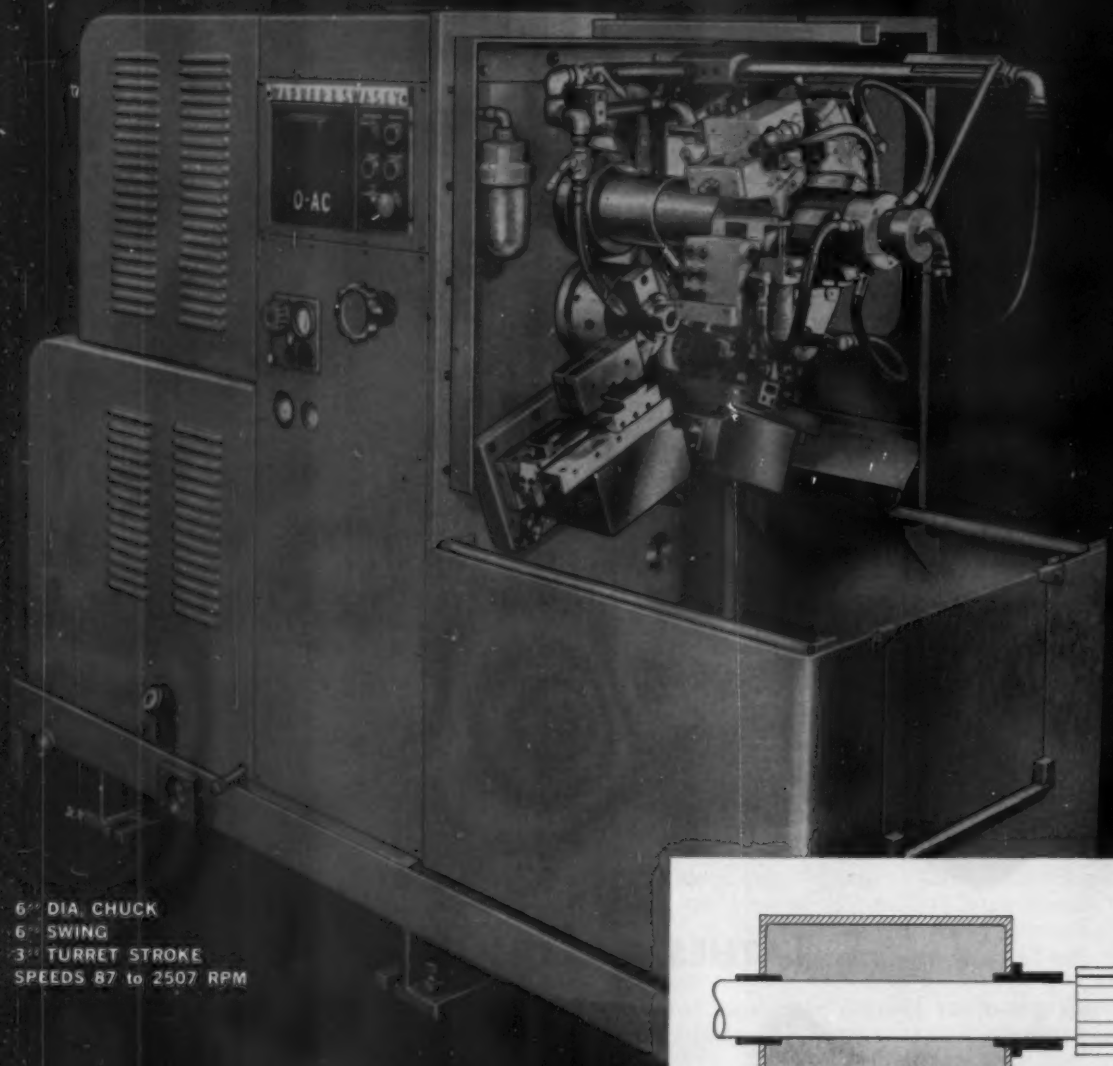
PRECISION DRAW-IN COLLETS

FOR YOUR
LATHES-MILLERS-GRINDERS

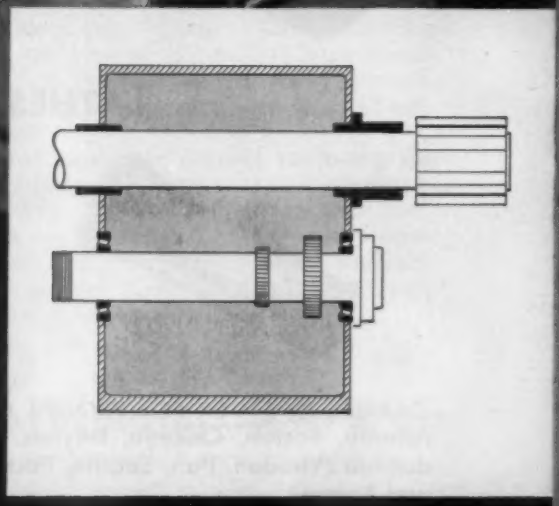
CARRIED IN STOCK FOR PROMPT DELIVERY IN:
Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, New York, Philadelphia (Yeadon, Pa.), Seattle, Portland, Minneapolis, Oakland, St. Louis, Springfield, N. J., and Toronto.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

NOW YOU CAN AUTOMATE PRODUCTION



6" DIA. CHUCK
6" SWING
3" TURRET STROKE
SPEEDS 87 to 2507 RPM



Spindle rise has been practically eliminated in the O-AC by placing the spindle and turret bearings in the same housing where they are subjected to exactly the same temperature, and continually lubricated with clean, filtered oil.

OF SMALL PRECISION PARTS with the New Warner & Swasey O-AC Single Spindle Chucking Automatic

Warner & Swasey's newest addition to its proven line of Single Spindle Chucking Automatics — the O-AC — is specifically designed to automate the production of small precision parts in all lot sizes — even as few as 30 or 40 pieces.

SMALL LOTS are profitable on the O-AC because it sets up fast and can be changed from job to job quickly and easily. There are no cams to design, change or store. The tooling area is uncluttered, easy to get to for faster cutter setting and adjustments.

PRECISION work piece tolerances and fine finishes on a repetitive piece-after-piece automatic basis are routine for this new single spindle chucker. Because of its unique overhead turret construction, only the O-AC can assure this high degree of production accuracy.

VERSATILE PERFORMANCE results from the O-AC's unique tool slide actions. A wide range of work — from ordinary small castings to complicated missile components — is efficiently handled, usually with low-cost standard tooling.

Your Warner & Swasey Field Engineer has the complete facts on the new O-AC ready for you. Or write us direct, Warner & Swasey Co., Cleveland 3, Ohio.

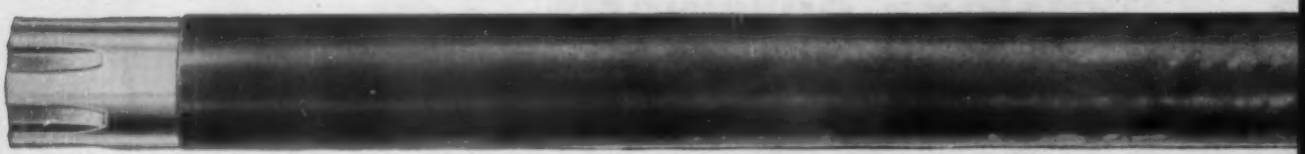
All automatic functions are rapidly set up by the simple placement of trip blocks and switch operating screws. All automatic functions can be individually hand controlled during setup and switched to "automatic" or back to "hand" at any time with a single control switch.

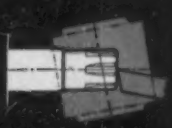
W S ®

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

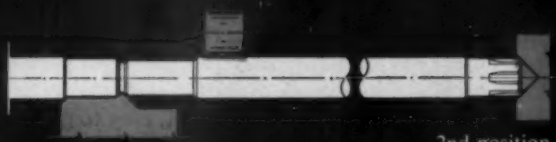
Acme-Gridley performs spline hobbing in a single set-up . . .

slashes wringer roll shaft production time 63%!

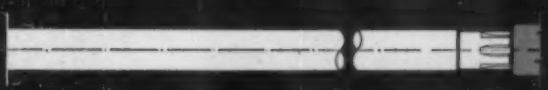




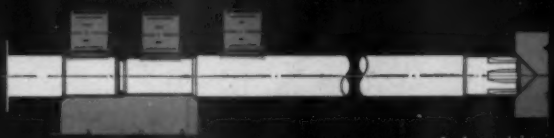
5th position
Hob Spline—Face Front (spindle clutch disengaged, spindle driven from hobbing attachment)



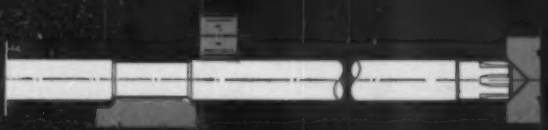
2nd position
Form Spline Dia. of Next Piece and Breakdown for Cut-off—Support



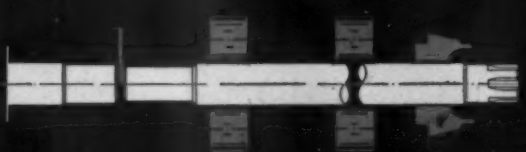
6th position
Feed Stock



3rd position
Shave Rear Dia. and Spline Dia.—Support



1st position
Form Rear Dia. Past Cut-off—Support



4th position
Support—Pick-up—Cut-off

6 Operations in 27.9 Seconds

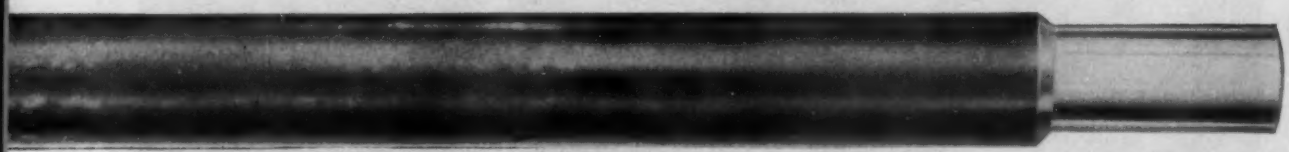
Here's how imaginative National Acme solutions to tough machining problems extend total machine capability and pay off in *tangible* production savings.

Spline hobbing is generally considered beyond automatic bar machine capability. Yet, an ingenious National Acme hobbing attachment . . . installed on an Acme-Gridley 1¼" RA-6 with modifications . . . lets a well-known manufacturer of wringer roll shafts do spline hobbing in the primary set-up; has cut per-piece production time 63%. In addition, a unique automatic feeding arrangement has drastically reduced stock-loading downtime.

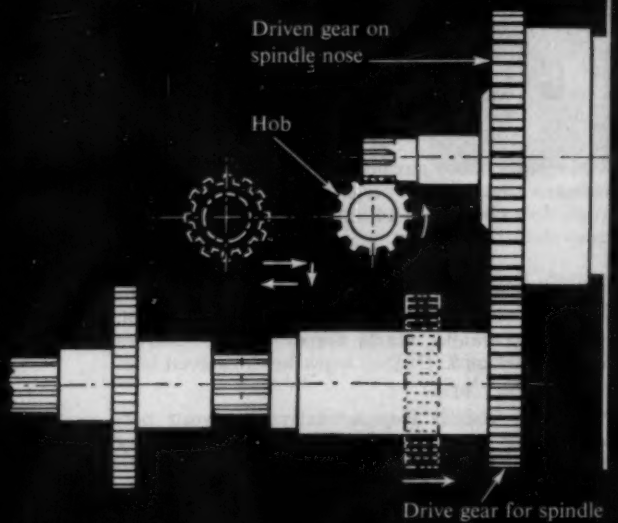
Special attachments like the spline hobber, plus such standard features as direct camming, independently operated toolslides, and a wide open tooling zone are the reason Acme-Gridley capability is limited by imagination only. No wonder cost-conscious manufacturers everywhere depend on Acme-Gridleys for higher mass production efficiency at lower cost. Detailed information on the world's most complete line of multiple and single-spindle automatic bar and chucking machines is yours for the asking. Call, write or wire.

National Acme's "Zone of Responsibility" includes all phases of cost reduction. Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by thousands of manufacturers . . . an "everyday" job for Acme-Gridleys. **Indirect Costs:** effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc. **Product Redesign:** teaming with your design group to take full advantage of Acme-Gridley's cost reducing capabilities. **Direct Material Costs:** our engineers provide important savings in this area by constantly matching machines and tools to modern metallurgical problems. **Make-or-Buy Reviews:** in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment. **Spot Modernization:** pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.



Spline hobbing in the fifth position . . . a closer look



When the hobbing attachment advances, a gear on the attachment engages a gear on the spindle nose and drives the spindle at the required speed for hobbing.

MMT-PE MODERN MACHINE TOOLS PRODUCTION EFFICIENCY

National Acme

THE NATIONAL ACME COMPANY
171 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

does both bar and chucking work

Why settle for less? The NEW Gisholt AR (Automatic Ram) brings automatic cycle efficiency to both bar and chucking work—gives you low-cost automatic production at fixed rates on both small lots and long runs.

Here are some of the advantages this new AR gives you:

1. Converts in 1 hour from chucking to bar work
2. Sets up as fast as any ram-type turret lathe—much faster than any other automatic
3. Saves time with infinite feeds, 16 speeds, plus a 25 h.p. motor to take full advantage of carbides
4. Machines more surfaces per chucking with: a hexagon turret and two cross-slide stations—up to a 15″ chuck—a 14″ turret stroke and 10″ cross-slide travel

With this new automatic, even a new man can get consistent quality at fixed production rates. He simply chucks, starts the cycle and removes the finished part. On bar work he does even less.

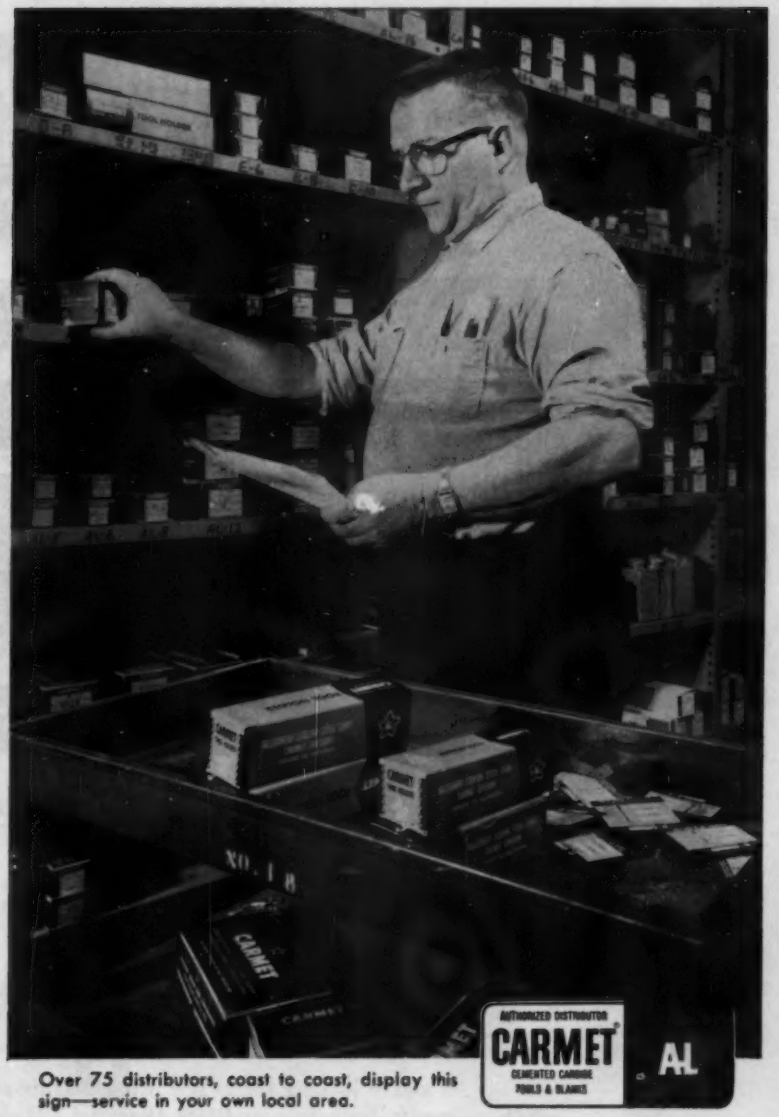
Ask your Gisholt Representative for your personal, desk-side demonstration showing how easy it is to set up and operate the AR. Ask him to explain the cost-cutting features that add up to increased profits on your work.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

Turret Lathes • Automatic Lathes • Balancers •
Superfinishers • Threading Lathes •
Factory-Rebuilt Machines with New-Machine Guarantee

Investigate Gisholt's Extended Payment and Leasing Plans

Off-the-shelf delivery of Carmet® Carbide Tools from your local CARMET Distributor



Over 75 distributors, coast to coast, display this sign—service in your own local area.

Keep your inventory of Carmet Carbide Tools at a comfortable level. Keep your working capital free for other needs. Your Carmet distributor carries the load—that's how he's set up to do business.

He carries your needs from the complete line of Carmet Carbide Tools in all grades and every style. He is geared to deliver your orders quickly—a phone call gets action.

And if you get in a production jam, special service is his middle name. Remember, your Carmet distributor knows carbide tooling—with the help of the local Carmet technical man, you get all the help you need.

Your Carmet distributor handles the best Carbide Tools and backs it with the best service! ***Allegheny Ludlum Steel Corporation, Carmet Division, Ferndale, Detroit 20, Michigan.***

CARMET® AL

CEMENTED CARBIDE • DIVISION OF ALLEGHENY LUDLUM

1300

LOOK FOR THESE TRADEMARKS

BUY WITH CONFIDENCE

If you're looking for as fine a blade as money can buy . . . specify Nicholson or Black Diamond. They're among the best respected brands in the metal-working industry.

Here's part of the reason why . . . we make our blades from the finest available steel, according to the latest manufacturing methods. We inspect them again and again. We approve only those blades that meet our high standards.

More important, you can be confident that you're getting quality blades to produce quality work.

A good many industrial blade users and buyers are switching to the Nicholson and Black Diamond brands. The best gauge of the way they like them is the way they keep reordering them. The next time *you* order blades . . . order Nicholson or Black Diamond blades. You'll be specifying the economy of top quality.

* ***Industrial Distributors provide the finest goods and services in the least possible time. Our products are sold exclusively through them.***

NICHOLSON NICHOLSON FILE COMPANY, PROVIDENCE 1, RHODE ISLAND

FILES • ROTARY BURS • HACKSAW AND BAND SAW BLADES • GROUND FLAT STOCK • INDUSTRIAL HAMMERS

See the whole Sheffield line in action at Booth 201

Machine Tool Show near the main entrance

Here are thread and form grinders that give you toolroom precision plus production line speed.

Plunge grind threads 1¼" long in a turn and a half or traverse grind long threads as fine as 60 pitch

And you have a choice of Crushtrue® wheel dressing (or multi-rib or single-rib diamond wheel-dressers) with manual or automatic crushing. Furthermore, Crushtrue dressing is ideal for grinding intricate profiles.

Sheffield's versatile standard Thread and Form Grinders (Model 101, illustrated, capacity 7" diameter x 12" long; Model 103, 7" diameter x 24" long) are equally at home in the tool room making one of a kind precision threads, or in the production line plunge grinding thousands of threaded or profiled parts.

Wheels may be diamond dressed . . . or Crushtrue® dressed for these advantages:

Greater production: wheel is sharper, grinds cooler. Faster stock removal: no dull flats, no burning, no loading up. Faster redressing: wheel is redressed in seconds. Highly accurate: tolerances on width within .0002", radii within .002", straight sides within .003". RMS finishes as low as 8 microinch, grooves as narrow as .020".

Standard accessories and special loading, holding, and ejection devices can be made available for specific high production jobs.

May we send you TFG 1159 catalog on models 101 and 103 and Bulletin CR 355 on the remarkable advantages of Crushtrue® grinding?

The **SHEFFIELD** *Corporation* *Dayton 1, Ohio*

A subsidiary of the Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.

if you use **LIVE CENTERS**

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1057-H Park Ave., Sycamore, Ill.
Send me the new Ideal Live Center Catalog.

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LETTERS

to the editors

330 W 42nd St, New York 36, NY

We Apologize

Dear Sirs:

In the article, "The case for stampings" (*AM/MM*—Apr 18 '60, p111), under the heading, "1959 Winner—Holding pin terminals to close tolerances," the following statement appears: "This result was achieved by producing terminal pins in progressive dies—saving Malco $114,000 a year . . ."

Please note that the saving was made by the *customer* and not by Malco Manufacturing Co. This error has caused some confusion, and your cooperation in rectifying it will be very much appreciated.

Harold R Drimilla, *vice pres*
Symonds, Mackenzie & Co
Chicago, Ill

Mistaken Identity

Dear Sirs:

On matters technical
You're the best,
But your history
Flunks the test.

Bess Ritter's story of St Clement (*AM/MM*—May 16 '60, p194) does not agree with history:

1. The only Saint Clement was the fourth Pope, Clement I. He reigned between 90 and 100 AD, and his feast day is celebrated on Nov 23.

2. The "bishop of Rome" is always the Pope.

3. The only Englishman to become Pope was Nicholas Brakespear, Pope Adrian IV, who died in 1159 and was a contemporary of Henry II, not King Alfred, who died in 901.

I enjoy and read "Memos" in each issue, but couldn't resist setting the record straight on this particular subject.

Jack E Ditzler
Overland Park, Kansas

On matters historical,
Ignorance is blith,
But our Bess said
'Twas "according to myth."—Ed

Micro 99 steel

Dear Sirs:

On your "Spot News" page (*AM/MM*—May 2 '60, p75), we read an item on Micro 99, a special grade of steel . . . However, the address of the firm concerned is not indicated, so we cannot apply directly for information.

SHOPMATES

N. Jarvis

— YOU'RE GONNA BE AWFUL MAD WHEN I TELL YOU WHAT HAPPENED — I — ER — UH —
NONSENSE!! ME GET MAD?? ANYBODY CAN MAKE A MISTAKE — JUST TELL ME WHAT'S BOTHERING YOU — CHIN UP — !!

Heppenstall Forgings meet rigid specifications of world's largest Klystron project

When an important military radar program needed a large power amplifier, Varian Associates were asked to deliver one in record time. For the precision forgings required–delivered on time–Varian turned to Heppenstall. In a record-breaking five months, a successful prototype of the VA-842 Klystron was delivered to the Transmitter Manufacturer. In the company's words, "The speed and efficiency of the VA-842 program was due almost entirely to the complete cooperation between all areas of the company and outside contractors." *For delivery and dependability . . . why don't YOU investigate Heppenstall Forgings!*

Made by Varian Associates, Palo Alto, California, this 12-foot, 900-pound Klystron produces tremendously high average power for long pulse radar.

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Plants: Pittsburgh, Pa. • Bridgeport, Conn. • New Brighton, Pa.

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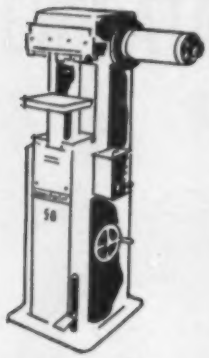
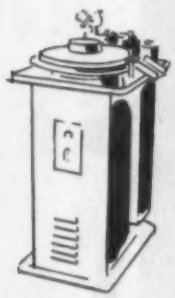
Die Blocks • Forgings • Back-Up Roll Sleeves • Rings • Industrial Knives • Materials Handling Equipment
Pressure Vessels • Hardened and Ground Steel Rolls • Vacuum and Consumable Electrode Melted Steels

Permanent INDENTED METAL MARKING

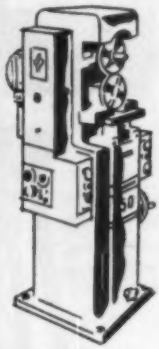
For over half a century Noblewest has been the leader in designing and building machines and tools for faster, better marking at lower production costs to users. Noblewest marking is *permanent indented marking* . . . good for the life of your product. Illustrated below are the basic types of marking equipment in the Noblewest line. It includes machines for marking, graduating, embossing and serial numbering at production speeds up to 15,000 pieces per hour with full automation. Whatever you want to *permanently* mark, it will pay you to specify NOBLEWEST. Write for comprehensive catalog. Noble & Westbrook Manufacturing Company, 17 Westbrook Street, East Hartford 8, Conn.



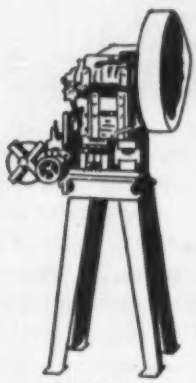
General purpose Roll-Marking Machines



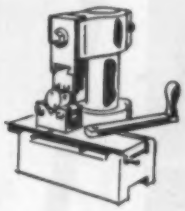
Rapid production Roll-Marking Machines



Precision Graduating Equipment



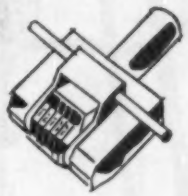
Mechanical and Pneumatic Marking Presses



Bench Marking Machines

Precision Marking Dies

Hand Marking Tools



Automatic Numbering Heads

A few desirable territories open to qualified representatives.

A few desirable territories open to qualified representatives

MARK IT BEST WITH NOBLEWEST IMPROVED MARKING DEVICES

NOBLEWEST

ORIGINATORS OF THE ROLL MARKING PROCESS

MARKING
NUMBERING
EMBOSSING
GRADUATING

We shall appreciate anything you can do to help us secure full information regarding the type of steel referred to in the item and whether it is suitable for the production of cutting tools.

Dan Ram, *tech mgr*
Chanita Metal Works
Chanita, Israel

Further details can be secured from the manufacturer of the material: Micromatic Hone Corp, Schoolcraft at Greenlawn, Detroit 38, Mich.

However, this grade of steel is not claimed to be a cutting-tool material—Ed.

More Addresses

Dear Sirs:

In your article on the "Highlights of the Tool Show" (*AM/MM*—May 2 '60, p95), you mention two Japanese machines: the Makino jig borer and the Shibaura planer-miller.

It would be appreciated by us if you could furnish us with the addresses of these firms.

Julius Stropp
Dearborn, Mich

The jig borer is made by Makino Vertical Milling Machine Co, Ltd, #83 Nakane-cho, Meguro-Ku, Tokyo, Japan.

The planer-miller is made by Shibaura Koki, #4, 2-Chome, Suehiro-Cho, Tsurumi-Ku, Yokohama, Japan—Ed.

"I have no trouble meeting my quota. I set up quickly, maintain a certain speed, work for perfection and cheat on my tally sheet."

CALENDAR

American Machine Tool Distributors Association—Annual Meeting, Sept 3-4, La Salle Hotel, Chicago, Ill.

National Machine Tool Builders Association—Machine Tool Exposition, Sept 6-16, International Amphitheatre, Chicago, Ill.

Production Engineering Show, Sept 6-16, Navy Pier, Chicago, Ill.

Coliseum Machinery Show, Sept 7-15, Chicago Coliseum, Chicago, Ill.

Society of Automotive Engineers—Farm, Construction, and Industrial Machinery Meeting Sept. 12-15, Milwaukee Auditorium, Milwaukee, Wis.

American Die Casting Institute—Annual Meeting, Sept 14-15, Edgewater Beach Hotel, Chicago, Ill.

American Welding Society—National Fall Meeting, Sept 26-30, Penn Sheraton Hotel, Pittsburgh, Pa.

Instrument Society of America—Instrument-Automation Conference & Exhibit, Sept 26-30, Coliseum, New York, NY.

Pressed Metal Institute—Annual Meeting, Oct 10-14, Shawnee Inn, Shawnee on Delaware, Pa.

Society of Automotive Engineers—National Aeronautic Meeting and Display, Oct 10-14, The Ambassador, Los Angeles, Calif.

Industrial Management Society—Industrial Engineering and Management Clinic, Oct 13-14, Conrad Hilton Hotel, Chicago, Ill.

National Safety Council—National Safety Congress, Oct 17-21, Conrad Hilton Hotel, Chicago, Ill.

American Society for Metals—National Metal Exposition and Congress, Oct 17-21, Trade and Convention Center, Philadelphia, Penna.

National Tool & Die Manufacturers Association—Annual Convention, Oct 19-23, Leamington Hotel, Minneapolis, Minn.

MEMO
Bill
Be sure to see the new Reed High Speed general purpose thread rolling machine. Also their new spline forming and gear burnishing machine
Booth 421 Chicago Exposition
MMT PE
Booth 421
Machine Tool Exposition
September 6-16, 1960
B150
IN OPERATION AT BOOTH 421
B150—Producing ⅜"-11 cap screws up to 200 per minute.
A425—Rolling spline on automotive transmission shaft.
B111—Thru-feed rolling ¼-20 bars.
A22—Hand feeding small lot run on heat treated parts.
A25
NEW MACHINES BY REED
B150—Large In-feed Thread Rolling Machine—5" Capacity
B910—General Purpose High Speed Thread Rolling Machine—1" Capacity
B150T—Large Capacity In and Thru-feed Thread Rolling Machine
A25—Simplified, Rugged, Thru-feed Thread Rolling Machine—2½" Capacity
A425—Involute Spline and Serration Rolling, and Gear Burnishing Machine—2½" Capacity
REED
REED ROLLED THREAD DIE CO.
Specialists in Thread and Form Rolling Tools and Equipment
HOLDEN, MASSACHUSETTS, U. S. A.
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ARMSTRONG

SET-UP *and* HOLD-DOWN TOOLS

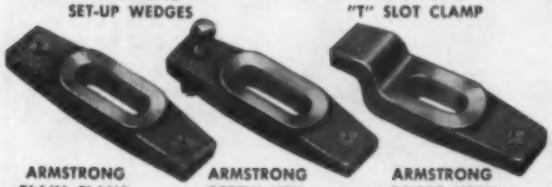
ARMSTRONG PLANER JACK — ARMSTRONG BRACING JACK — ARMSTRONG VERTICAL JACK — ARMSTRONG ADJUSTABLE STEP BLOCK

ARMSTRONG "T" SLOT BOLT — ARMSTRONG "T" SLOT NUTS

ARMSTRONG NUTS — ARMSTRONG WASHERS

ARMSTRONG UNIVERSAL ADJUSTABLE CLAMP

ARMSTRONG SET-UP WEDGES — ARMSTRONG "T" SLOT CLAMP



ARMSTRONG PLAIN CLAMP — ARMSTRONG SCREW HEEL CLAMP — ARMSTRONG GOOSE NECK CLAMP

ARMSTRONG DOUBLE FINGER CLAMP — ARMSTRONG FINGER CLAMP — ARMSTRONG "U" CLAMP

Whatever its shape, a work piece can be quickly, easily and safely set up on any T-slotted table with ARMSTRONG Set-up Tools. Comprising a complete "system" of supporting and holding devices in all essential sizes, ARMSTRONG Set-up Tools usually pay for themselves on the first job and continue to lower costs for years to come.

Save Time: Keep costly machines and high priced men producing—save time otherwise lost while operators rummage in the scrap box for materials with which to devise makeshift set-up methods.

Prevent Breakage and Spoilage—correctly designed, machined from special steels or drop forged and heat treated, they are extremely stiff, strong and reliable.

Increase Accuracy—hold work rigidly and support it fully regardless of shape.

Prevent Accidents—end risk of set-up failure with resulting tool breakage, damage or personal injury.

Increase Profits—by reducing down time, increasing man hour output, assuring accuracy, ARMSTRONG Set-up and Hold-down Tools cut costs and build profits. They are part of every properly equipped tool room and shop.

Your Local Armstrong Industrial Distributor carries a good stock of Set-up and Hold-down Tools. He offers you quick, efficient service on these, as well as other, quality ARMSTRONG Tools.

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When you think of
FLEXIBILITY

Lucas provides

Lever control.

Pendant control

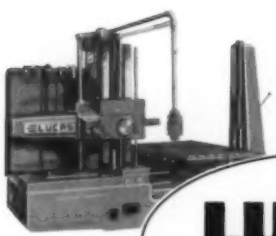
Tape control

and a variety of combinations of the three for flexibility of control suited to the type of work required.

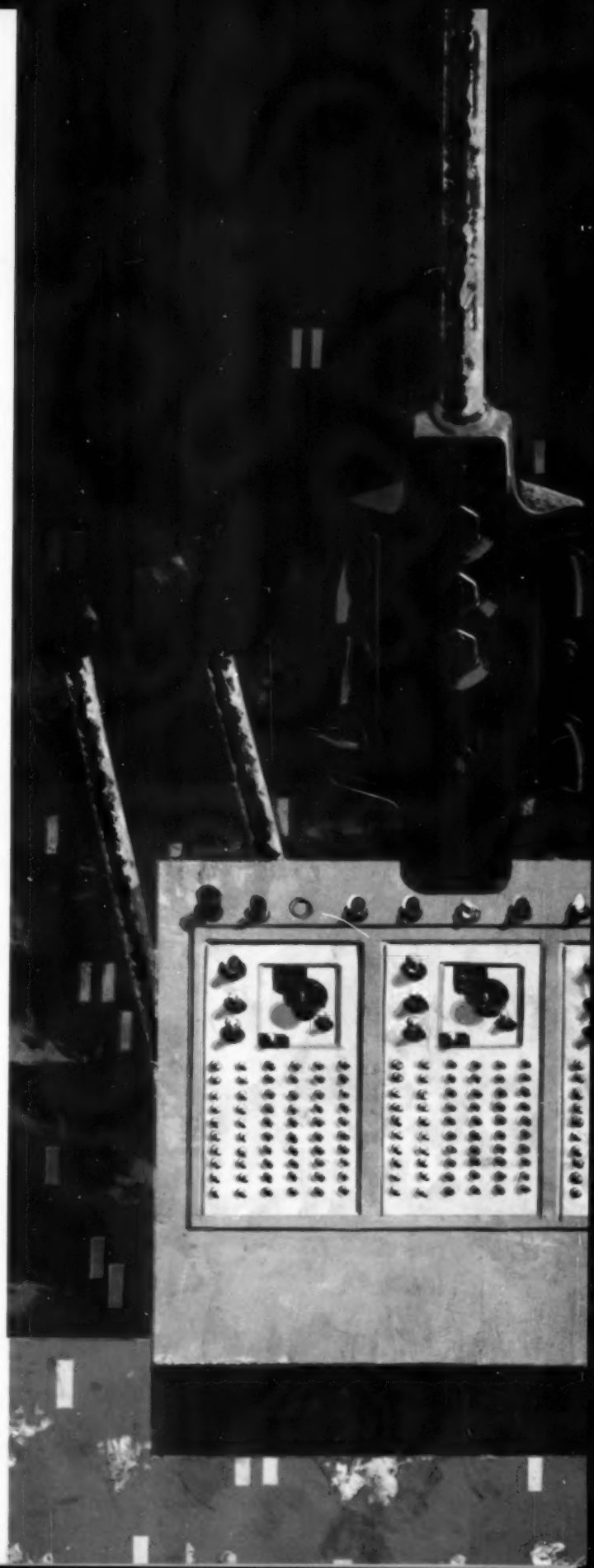
For example . . . The Multiple Control Pendant selects speeds, feeds, unit travels, rapid traverse of head, table, saddle and spindle, plus the rotation of the spindle forward and reverse, jog and stop. Speeds and feeds can be pre-selected while the machine is in operation.

Practical applications of these controls are spelled out in a new catalog. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of flexibility . . .

think of . . .



LUCAS
PRECISION



When you think of VERSATILITY

Lucas feeds the saddle ⇐

Lucas feeds the spindle ⇒

Feeds both in combination ⇒⇐

when necessary.

Combine these motions with

Vertical spindle head travel ⇕

and horizontal table travel ⇔

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if you need it.

The result . . . no machine tool can offer a greater combination of usable motions for boring, drilling, milling and related work.

Over twenty models and a dozen major attachments. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of versatility . . .

think of . . .

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SPOT NEWS...

- **Numerically controlled machine tools are more than paying their own way.** In fact, they are such profitable investments that additional numerical controlled units will be purchased as rapidly as funds permit, according to representatives of five aircraft and missile manufacturers.

- **Unitized frame design is expected to knock 30% off the cost of the car** Toyota (Japan) is readying for the American market. The Toyopet Tiara was originally scheduled to sell here for $2300, but after the switch to a unitized frame it will sell for $1650. Horsepower has been stepped up from 68 to 75 hp to overcome earlier model's slow pickup and low maximum speed.

- **From 26% to 29% of all machine tools in four of Russia's major economic** regions are more than 20 years old. This was brought out at the recently completed plenum meeting of the Central Committee. It was also noted that the Soviet machine building industry requires some 60,000 engineers this year, but will get only 24,000.

- **Single automated line at John Deere produces 720 plow shares of all sizes,** only two inspectors servicing entire line from forging to packing, Alan C Mattison, president National Machine Tool Builders' Association, said in statement before Subcommittee on Automation and Energy Resources of Joint Economic Committee. Special Mattison grinder, part of the line, takes parts from conveyor, locates and clamps them automatically, finishes bevel from end position in single straight pass, maintains rigid tolerances, unclamps and unloads the share and deposits them on conveyor.

- **Emphasis on numerical control is expected in one of the military services.** *AM/MM* has learned that this service probably will not approve purchase of any machine tools without numerical control for modernization programs. This does not apply to new facilities.

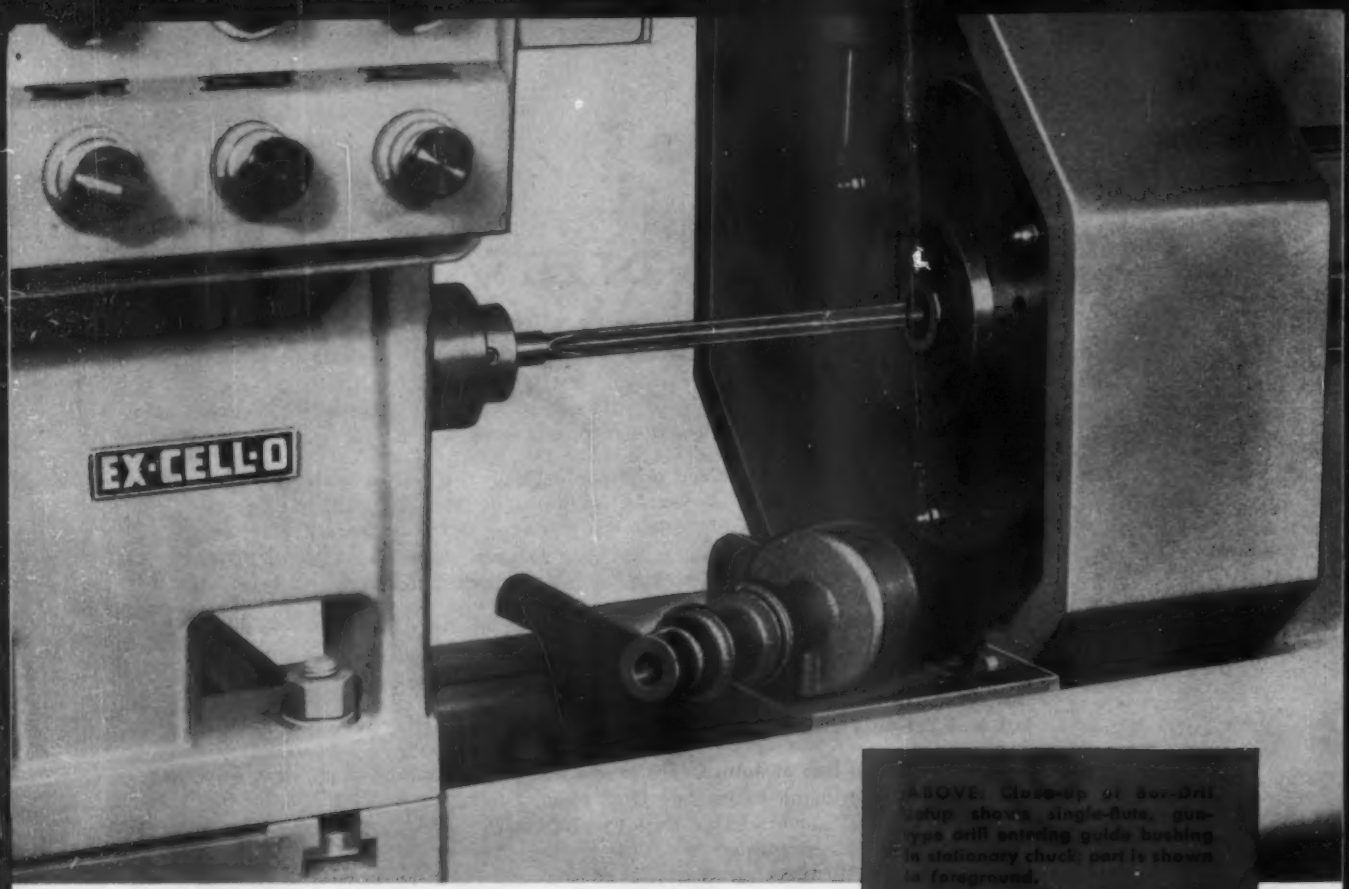
- **ASTME has proposed an ASA study on use of the decimalized inch.** American Standard Drafting Manual, Y14, recognizes decimal dimensioning but does not go into any detail. The new study, if approved, would be aimed at the eventual development of a complete system of decimal dimensioning.

- **Exports of Italian machine tools reached the highest level** since the Korean War in the first quarter of this year. They're running better than 45% above last year's pace for the same quarter, nearly $30 million annually. Imports are running almost as high as exports, a pace about double that of a year ago.

- **Defense Department has revised its Directory of Metalworking Machinery.** This complete listing of machinery producers and a breakdown of types of equipment is the most detailed machine-tool catalog ever compiled. Two-volume Directory can be purchased for $7.50 from the Superintendent of Documents, U S Government Printing Office, Washington, D C.

- **Kearney & Trecker Corp will probably ship more numerically controlled** machine tools than conventional units during 1961, according to K&T's president, Francis J Trecker. He said that the company today is turning out two Milwaukee-Matics each week, has sold more than 80 of these numerically controlled units, and already has 48 of them installed and in use in customers' plants.

- **Unofficial reports have it that the money saved by cancellation of Corvus,** the Navy's missile project, will be put toward a new longer-range system called Raven. The Navy dropped its 100-mile plane-launched guided missile Corvus after spending $80 million on the project.



DEEP HOLES FROM THE SOLID, ROUND AND STRAIGHT WITHIN .0005"—

Bor-Drilled in 30 seconds!

A cast-iron automotive distributor base in high production requires a central hole 6⅞" deep by ⅝" diameter. Hold both concentricity and diameter to .0005" tolerance; finish the I.D. to 15 RMS or better. *How many operations would you specify for the job—drilling, reaming, plus honing or lapping?*

Actually, your process sheet needs only one notation—*Bor-Drill*

Bor-Drilling is Ex-Cell-O's method of producing accurate holes from the solid with standard or special Ex-Cell-O Precision Boring Machines. The process utilizes a rotating gun-type drill; chips are cleared out the single flute of the drill by high-pressure coolant oil fed through the Ex-Cell-O Precision Spindle.

Ask your Ex-Cell-O Representative about this faster, better way to get a finish-machined small hole 12" deep or more *in one operation.* Or write direct for a free descriptive booklet on Bor-Drilling.

ABOVE: Close-up of Bor-Drill setup shows single-flute, gun-type drill entering guide bushing in stationary chuck; part is shown in foreground.

BELOW: Cutaway of part reveals quality finish of Bor-Drilled hole.

BOTTOM: Equipped for Bor-Drill operation, Style T13-O Precision Jig Boring Machine precision-finishes long hole from the solid in 30 seconds.

SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

MMT-PE

EX-CELL-O CORPORATION
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EX-CELL-O FOR PRECISION Machinery Division

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EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

CIRCLE 200 READER SERVICE CARD

WASHINGTON... TRENDS

Defense spending outlook . . .

The outlook for a hefty boost in military expenditures now seems more likely than at any time since Eisenhower clamped budget restrictions on defense outlays 7½ years ago.

The Democratic platform, and proposals over the past few years from Democratic congressional leaders commit the Party to substantial increases in the defense budget if it wins the White House in November. Senator John F Kennedy, the Presidential nominee, calls for a boost of $2.5 billion to $3 billion annually over the Eisenhower administration's $41 billion military budget. The rate of Pentagon spending has been kept at this level for three years now.

Vice-President Nixon, the Republican nominee, in his celebrated "accord" with New York's Governor Nelson Rockefeller, has also accepted the view that there are serious deficiencies in the U S defense posture and that the military budget has to be jacked up. This represents a significant philosophical shift for Nixon.

What would benefit . . .

Pentagon planners are brimming over with projects they would like to beef up when and if the new man in the White House approves a big budget boost.

The likeliest beneficiaries: Modernization of Army forces; Air Force ICBMs; the Navy's Polaris program; an airborne bomber alert; anti-submarine warfare; and reconnaissance and warning satellites.

Army modernization is the least controversial of the programs and rates a high priority with Democratic critics of defense policies.

The Army has already worked up a $1-billion shopping list of what it would buy over and beyond current procurement schedules to begin a full-scale modernization program. It includes $61.6 million worth of M-14 rifles and 7.62-mm ammunition, and shoulder-fired assault rockets and grenade launchers; $93.7-million worth of M-113 armored personnel carriers, M-60 main battle tanks, tank ammunition, and infra-red fire-control for tanks.

Also $193.1 million worth of tactical vehicles — "Goer" cross-country transport vehicles, amphibious Arctic personnel and cargo carriers, tank transporters, over-the-beach combat transporters, armored command and recon vehicles, combat recovery and repair vehicles, mine detecting and clearing devices, rolling fluid transporter, and ¼- to 10-ton vehicles.

Aircraft rates high on the list: Mohawk surveillance planes, the Iroquois transport helicopter, medium troop and cargo helicopters, Caribou battlefield transport planes, Seminole combat command and control planes, aerial cranes, and Chinook heavy helicopters.

More complaints on AF contracts . . .

General E Anderson, head of the Air Materiel Command, has sent a scorching letter to some 50 major contractors and to the leading defense contractor organizations, reporting findings of a special AMC plant investigation of contract pricing techniques of seven large representative prime and sub-contractors.

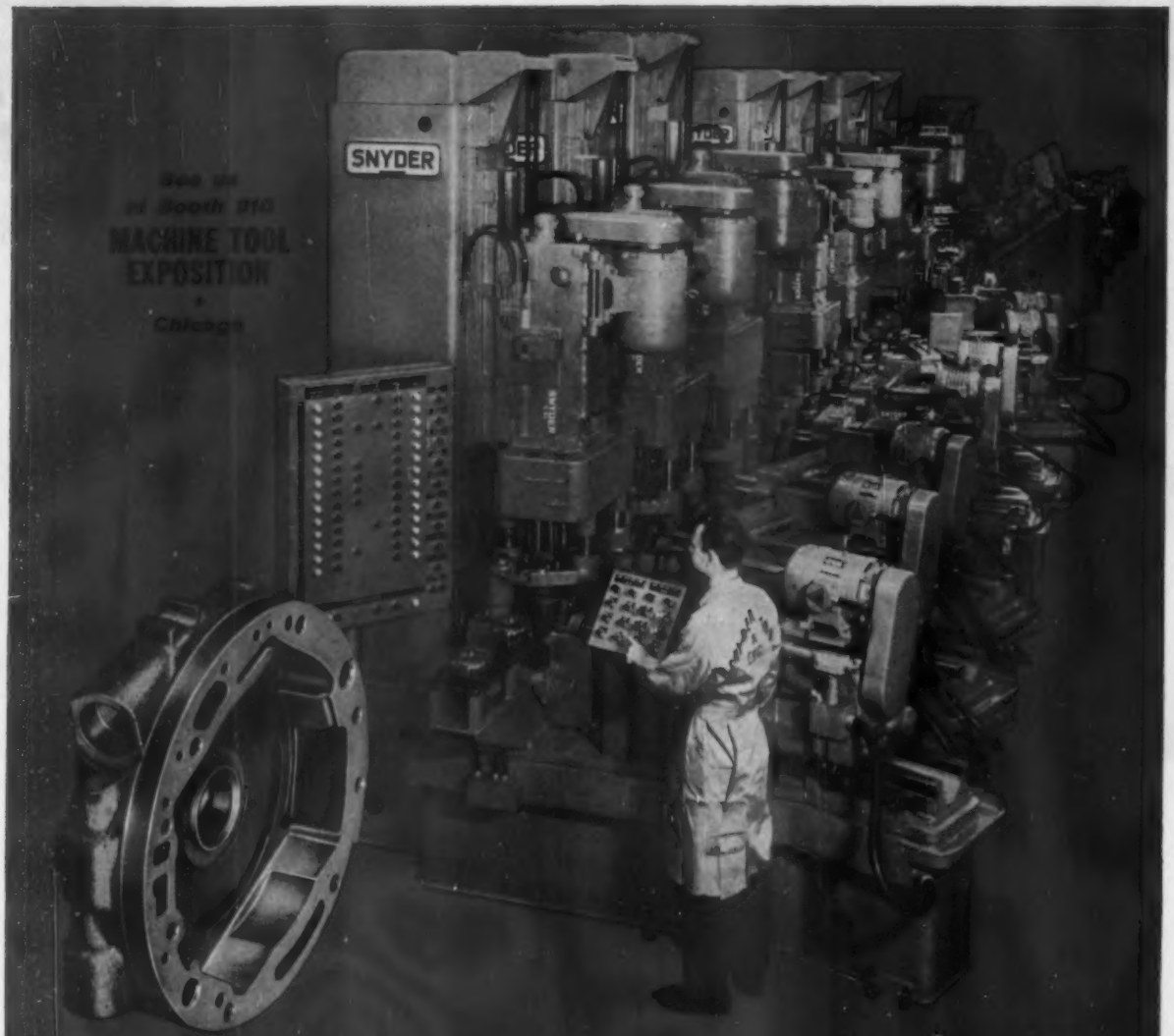
The inspection was part of AMC's drive to tighten up control over contractor cost estimates. This was at issue in recent GAO reports on inflated costs and excessive charges on contracts where costs are a factor in setting prices. The inspectors went out to see how contractors are adhering to new rules on pricing.

In four of the seven plants visited, the inspectors found "unrealistic overhead costs" charged to the Air Force. Three plants were accused of making "inflated materiel estimates." Three had "no established estimating system" to audit costs submitted by important subcontractors. Two companies refused to submit cost breakdowns to justify estimates. Only one firm submitted price exhibits. None "considered" unit-cost reduction benefits from large-scale production runs.

General Anderson warned that more "aggressive management" and "greater enforcement of management policies" was needed on prime contractor supervision of sub-contractor estimates and on submission of the primes' cost figures to the Air Force.

Atlas bases behind schedule . . .

Washington is revamping management of ICBM base construction to speed building work and to prevent delays at future missile sites. Construction of the first four Atlas sites is running three to six months behind schedule. Major factors in the delay: (1) Jurisdictional disputes between missile manufacturers and their industrial union workers, on one hand, and construction contractors and their building trades union men; (2) a flow of change orders in construction specs; (3) a muddled separation of responsibilities among the four military commands in charge of activating the bases.



SNYDER BUILDING-BLOCK PRINCIPLE MAKES TRANSFER MACHINES VERSATILE, CONVERTIBLE, THRIFTY

Transfer machines built up on the "building-block" principle are old stuff at Snyder and we've built all kinds of them—including the ones that turn corners and bring the part back to where it started from, processed from half-a-dozen angles, gaged, probed, automatically inspected in process, washed and dried and rejects marked for re-processing. Nothing to it if that's what the job calls for. We call it the Snyder Building-block Principle.

Here's an example of a fairly simple Snyder building-block transfer. This 55 station machine performs 74 operations on an automatic transmission pump body, drilling, reaming, tapping, gaging and probing 180 parts an hour at 100% accuracy. Any or all of its 22 segments can easily be converted to perform comparable operations on other parts. Also, the number of segments can be reduced or increased at any time, as need dictates. Your inquiries are invited.

SNYDER
CORPORATION
(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0122

DETROIT...

L'affaire Newberg . . .

The so-called Newberg affair at Chrysler is exciting the interest of all Detroiters. After 64 days as Chrysler's president, William C Newberg abruptly resigned, agreeing to pay back profits in excess of $450,000 accruing to him from his financial interest in vendor companies.

Mr Newberg apparently rationalized that personal profiting from vendors was in his employer's interest as long as price, quality and delivery were right. Newspaper articles the past two weeks have been giving details of what has been going on.

It may be quite a while before Detroit has heard the last of this affair. Chrysler stockholder Sol Dann, a Detroit lawyer, who owns 5100 shares of Chrysler stock, plans to petition for a grand jury investigation and claims to possess damning affidavits affecting at least five Chrysler suppliers.

The UAW-CIO, charging that diversion of work from Chrysler plants to favored suppliers has cost thousands of jobs, has demanded a full-scale inquiry.

It is hardly news to report that all automobile companies have been moved by the Newberg affair to take a new and close look at their own supplier relationship.

Aluminum bumpers will debut . . .

The 1961 model of at least one compact car will be equipped with aluminum bumpers, the first ever to be put on the commercial market.

Bumpers will be made by the Reynolds Metal Co's warm-forming method. The system eliminates much of the tooling and finishing necessary when working with cold sheet metal.

Tooling expenses will be cut by 50%. Actual cost of bumpers, it is said, will be reduced 10 to 20%. The new bumpers will be 50% lighter than present bumpers and just as strong if not stronger, according to Paul O'Brien, director of automotive processing research for Reynolds.

Reynolds' warm-forming method consists of heating aluminum extrusions, of proper cross section and pre-cut to length, in a controlled-atmosphere furnace to around 1000 F. The hot metal then is transferred to heated dies where one stroke of the press forms all major configurations.

The bumper is quenched to room temperature after which the final operations are performed —molding holes are punched and bumper ends cupped to proper shape. A final heat treatment for hardness buffing, and application of anodic coating finishes the job.

Aluminum bumpers have been an on-again off-again subject in the automotive trade for years. They have been installed experimentally on trucks, buses and passenger cars with little success over a long period of time.

Now, with the Reynolds process and the success of compact cars, where weight is a vital factor, aluminum stands to score its second major breakthrough in the auto parts and trim field in the past two years. The first was an arrangement whereby Reynolds supplies to Chevrolet molten aluminum for use in the latter's new aluminum foundry for manufacture of Corvair engines by a new low-press molding process. Low-pressure molding is a step between die casting and permanent mold casting.

It has been successful in European foundries. The Chevrolet method is said to use many modifications of the European process.

The aluminum industry has been keeping Detroit conscious of its product through advertising in mass media, pointing out why aluminum should be used by automobile makers.

Aluminum Co of America reports that most automobile companies have adopted brightened-up aluminum alloys for decorative car trim on their 1961 models. The new Alcoa process reputedly produces optimum mirror-like qualities, without any sacrifice of other important coating characteristics.

Unsinkable aluminum . . .

When Army Ordnance awarded truck development contracts to Ford, Reo and General Motors 12 months ago, it specified that the new vehicles should be lightweight so that they could be airborne and floatable and thus could be towed across rivers and other streams.

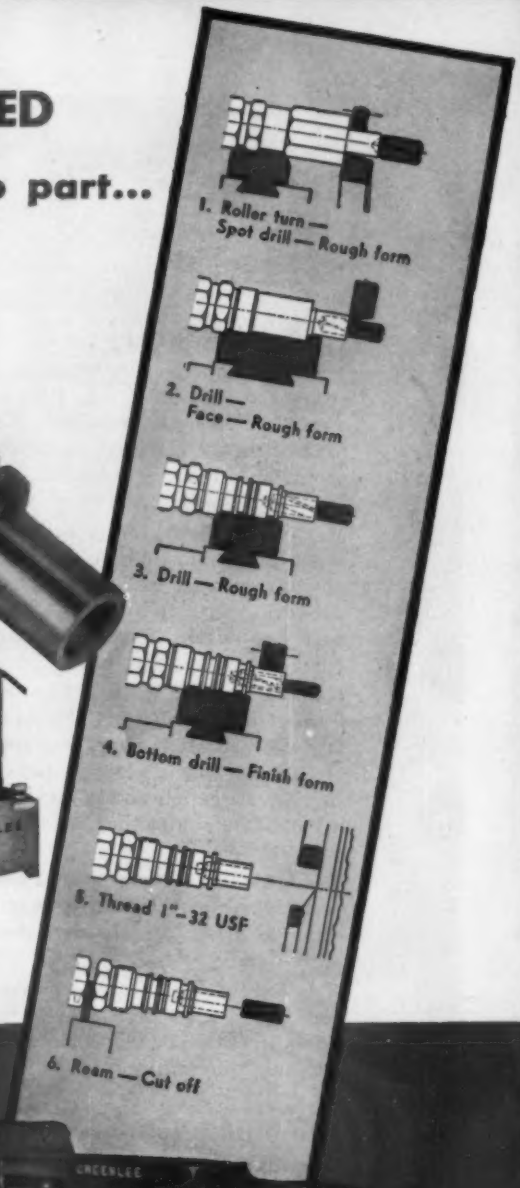
General Motors and Ford have now delivered 3½-ton and 5-ton military cargo and personnel carrying trucks with bodies and cabs made exclusively of aluminum.

They not only float, but also are maneuverable and can furnish enough power through the churning sidewheel effect of the deep-treaded driving wheels to propel themselves through the water.

When equipped with an optional propulsion kit that includes a rudder and propeller, the Ford truck can plow through smooth water at 6 miles an hour. Top land speed is 50.

GREENLEE AUTOMATICS SPEED PRODUCTION of precision pump part...

The part is the injector cylinder of the Greenlee No. 798 High-Pressure Portable Power Pump manufactured by Greenlee Tool Co., a division of Greenlee Bros. & Co. Since the pump is capable of developing pressures up to 10,000 psi, extreme precision is required in producing the cylinder. It is machined from 1-inch hexagon 4150 chromium-molybdenum steel at a gross production rate of 48 pieces per hour. Sequence of the 13 operations performed is shown at right. Your Greenlee representative will be glad to help solve your precision part problems . . . just send us a print.


1. Roller turn — Spot drill — Rough form
2. Drill — Face — Rough form
3. Drill — Rough form
4. Bottom drill — Finish form
5. Thread 1"–32 USF
6. Ream — Cut off

GREENLEE

Transfer Machines • Special Machines • Automatic Bar Machines
Die Casting Machines and Trim Presses • Woodworking Machines
Tools for Woodworking • Hydraulic Tools for Craftsmen

GREENLEE BROS. & CO.

1879 MASON AVE.
ROCKFORD,
ILLINOIS

AIRCRAFT and MISSILES...

TRENDS

Missileer contract to Douglas . . .

The Navy has chosen Douglas Aircraft Co to develop the Missileer aircraft, which is to be launching platform for the Eagle, the Navy's air-to-air long-range guided missile.

Navy says the development contract will be forthcoming shortly, but declined to disclose anticipated costs of the Missileer program.

The Eagle will provide the Navy's carrier force with a continuous air alert defense, and will be capable of striking at all enemy aircraft.

The future of manned aircraft . . .

The Defense Department and the aircraft and missile industry hope to get some definite ideas on the future of manned aircraft soon.

Industry wants to know how much aircraft work will be available, what kind of work it will be. The Pentagon wants to get some realistic estimates of what such work will cost.

A joint meeting of the Defense Department and the Institute of Aerospace Sciences will probe the entire range of manned vehicles — from subsonic VTOLs to the Dyna-Soar.

The armed services are expected to present a detailed review of future aircraft requirements as they now see them. The technical means available now and those expected to be available in the future to meet military requirements will be discussed by NASA.

Beryllium gets a boost . . .

Increased emphasis on development of beryllium as a structural metal has been recommended by NASA's Research Advisory Committee of Structural Design.

Development costs, though expected to be high, appear warranted by weight gains that beryllium would offer on third-generation space vehicles, which are expected to have greater internal volume than the Mercury capsule and its follow-on vehicle.

Nose cone for Atlas-Centaur . . .

Convair-Fort Worth has just announced the completion of the first nose cone for the Atlas-Centaur space vehicle.

Built entirely of fiber-glass sandwich material, the cone is 10 feet across the base and 18 feet high. The honeycomb core is bonded between layers of glass-reinforced plastic.

Centaur is scheduled to be the first U S space craft with as much power as the Russian "Lunik" series. It would be able to place a 9000-lb payload in orbit or land a half-ton on the moon.

The new nose cone will be shipped to Convair-Astronautics, builder of the Atlas-Centaur for NASA. Later cones will go to Cape Canaveral.

Mach 3 airliner urged . . .

"There is certainly no question that if Russia is first with a good supersonic transport, it will have a profound effect on our international stature and they will have little difficulty in selling the aircraft, perhaps even to our American flag carriers, and very possibly to our domestic trunk lines" says Orval R Cook, president of Aerospace Industries Association.

Cook goes on to say that there is no doubt of the technical capability in the U S aerospace industry today to develop and manufacture a Mach 3 airliner. There is a Mach 2 bomber and considerable development work has been done on a Mach 3 bomber. Estimated initial development costs range from $250 million to nearly a billion dollars.

West Coast labor picture . . .

Though most of the major strikes in the aircraft and missile industry were settled several weeks ago, there have been a number of recent developments.

IAM membership at Aerojet-General plants in Sacramento and Azusa agreed overwhelmingly to accept the company's latest offer. New contract covering 8000 workers includes a 2¢-an-hour cost-of-living increase, substantial improvements in group insurance benefits for employees and dependents, and an improved pension plan.

Aerojet-General also agreed to 5¢-an-hour general wage increase and a 6¢-and-hour cost-of-living adjustment effective May 1961. The contract is retroactive to May 28, is effective through July 1963.

Also on the labor front, court-ordered arbitration is under way between Douglas Aircraft Co and the Southern California Professional Engineers Association. The SCPEA took Douglas to court over the company's refusal to arbitrate a 10% pay cut for 450 top-salaried engineers. Earlier this year, Douglas scheduled a flat 10% pay cut for all salaried personnel, but later limited the reduction to those earning over $13,000 a year. SCPEA claims the engineer's pay cut is in violation of contract.

"The fabulous '60s, with tremendous technological advances predicted, will require this type of perfectionist precision tool . . . and, son—

Here's why Lufkin's indicator is the most sensitive!"

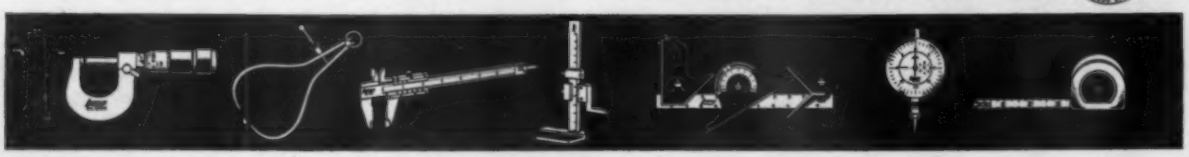
It is made with the precision of a fine watch, with jeweled bearings for longer life.

Lufkin's V32 Dial Test Indicator has a 180° contact point swivel. The dial has clear, easy-to-read graduations to .0001". . . and a switch lever for full reverse action.

Exclusive ball-bearing mounting reduces friction, assures greater accuracy—an excellent example of how Lufkin leads in precision-tool design.

Mount the V32 on a Lufkin Miti-Mite Holder with its rigid (5/16") center post and you have a vertical testing setup that will stay firmly in place. (There's a permanent magnet in the base with a 50-lb. pull.)

See your industrial distributor. He knows precision tools and can show you how Lufkin leads in design and craftsmanship. His stock is maintained to fit your needs. See him for prompt and reliable service. LUFKIN, Saginaw, Mich.



MACHINE TOOLS...

Auto tooling programs loom . . .

Prospective machine tool orders from the automobile industry have brightened. The main reason is that aluminum engines will be the thing in the 1963 model year. But some car makers are trying for '62 models (to be introduced in the fall of 1961) on a crash basis.

Oldsmobile, for one, has asked for quotations on a line to build 330 cu in. displacement V-8 aluminum engines for '62 cars.

Buick and Pontiac also are reported considering big new V-8 aluminum engines, but they probably will be for '63 models.

Chevrolet is said to have in the works a rush program for aluminum fours and sixes. Machine tool orders should be placed soon.

Ford is having machines rebuilt for a new aluminum V-8 engine to be produced at its Cleveland engine plant. It likewise is considering a 4-cylinder (probably cast iron) engine for its forthcoming 85-in. wheelbase car — the compact compact. There still is talk about importing the engines for this car, but chances are good that it will be manufactured here.

A prominent machine tool builder incidentally is now rebuilding a six-machine engine block line for Ford's Cleveland engine plant.

American Motors is expected to place orders for machine tools for a new engine.

New transmissions as well as engines figure in important tooling prospects. Chevrolet has a new transmission program under way for its new Mound Road (Detroit) plant.

General Motors transmission plans, which lately have been in the deep freeze, have been taken out and orders may be cooking before long. This transmission may well wind up in the '62 Pontiac.

Reports are circulating that Chrysler is reviving its Kokomo, Ind, transmission program.

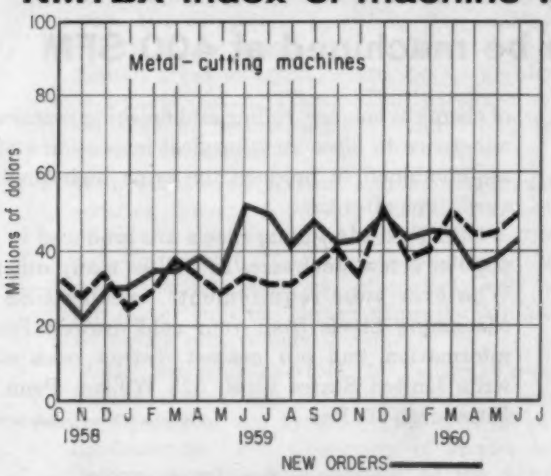
On top of the flurry of automotive tooling business at Detroit is the certainty of further sizable orders from European automobile companies.

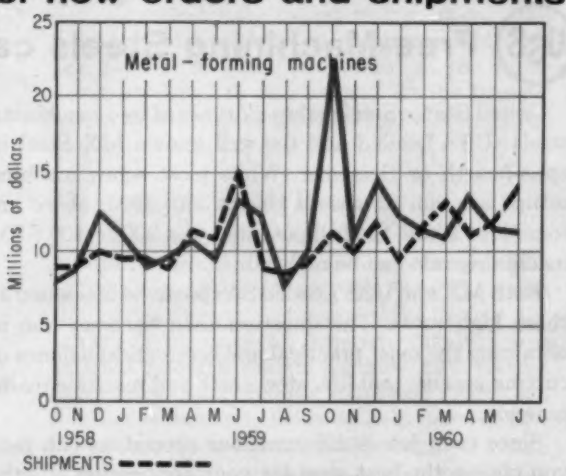
Fiat, Opel and most of the British car makers will be purchasing machine tools for expansion of their facilities.

Foreign orders continue high . . .

Foreign new orders for machine tools amounted to 26% of the total net new orders for metal-cutting and metal-forming types during the first six months of this year. In a number of companies the ratio of foreign business to total dollar volume was 35 to 40%, and in a few cases 50%. A surprising amount of orders has come from Japan. Press builders are doing better, with much of the demand originating in the domestic and European automobile industries. One builder reports that about one-fifth of its backlog is for customers abroad.

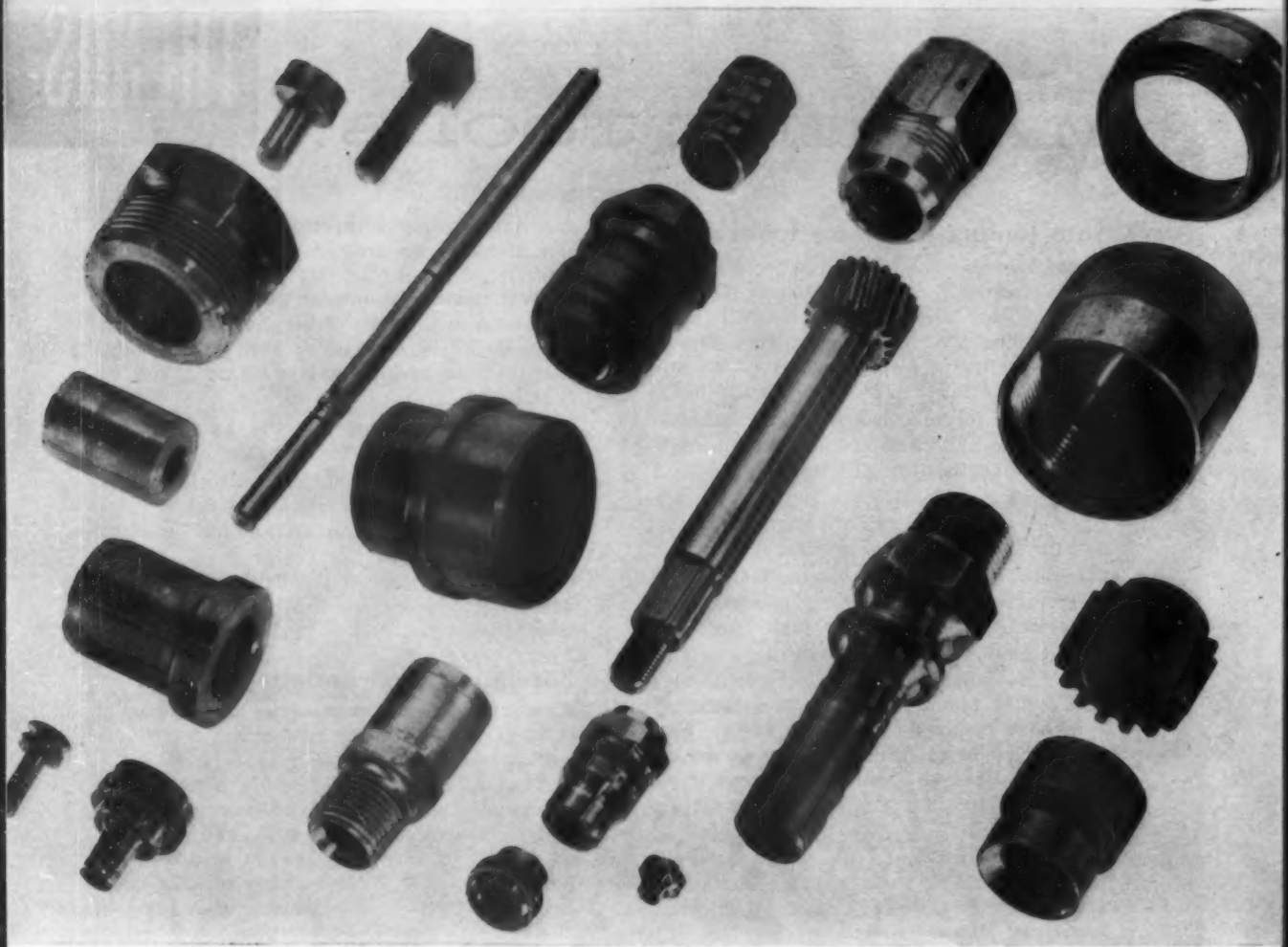
NMTBA Index of machine tool new orders and shipments





New orders for metal-cutting machine tools continued to rise in June, reaching a figure of $43,200,000, according to preliminary figures from the National Machine Tool Builders Association. Orders in May were $37,950,000. Shipments in June reached $49,850,000, up from $44,300,000 in May. Orders for metal-forming machine tools ran to $11,800,000 in June, down slightly from $12,000,000 in May. Shipments rose to $14,400,000 in June, up from $12,050,000 in May.

This mark tells you a product is made of modern, dependable Steel.



Note fine finish and clean-cut threads.

Want faster cutting speed?

USS Free-Machining Steels can be machined at 400 SFM

United States Steel makes *all types* of free-machining steels—USS Leaded and the well-known MX Steel in open-hearth or Bessemer. While most screw machine setups are run at speeds under 300 SFM, there are some jobs where the full potential of a 300 to 400 SFM machining rate can be realized.

Both MX and USS Leaded Steels can be machined at these high rates. The question then becomes one of obtaining the most practical and economical balance of cutting speeds, tool life, steel costs and machine maintenance.

Since each job is different, our specialists can help you choose the best steel for your application . . . the one that will give the highest production rate consistent with good machining and fine finish.

In any case, remember this . . . at United States Steel, good steelmaking practices are the rule. Careful control of chemical balance, rolling and finishing practices, and adherence to close metallurgical inspection standards are combined to produce the same high-quality bar stock time after time.

USS Free-Machining Steels are produced in all the popular screw-stock sizes as well as many other sizes. Whatever your requirements, specify USS Free-Machining Steels from your cold drawer. For more information, call our nearest district sales office or write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and MX are registered trademarks

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American Steel & Wire—Cleveland
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

TRENDS

MATERIALS...

New theory about rust . . .

Scientists at Westinghouse Research Laboratories advance a new basic explanation for the corrosion of iron — that hydrogen ions, or protons, are the cause. Hydrogen ions are present in water vapor, which must be present if iron is to rust to any great extent at room temperature. The new theory suggests that the tiny hydrogen protons penetrate the surface of the iron and enlarge the sites at which oxygen normally combines with the metal.

Electrochemical reaction, until now, has been the "accepted" explanation for iron corrosion. Now, it is believed that something more fundamental takes place in the iron, even though an electrochemical reaction also may be present. Experiments showed that dry oxygen and iron form a protective coating of oxide, while less than one part of water vapor in 200 parts of dry oxygen results in an entirely different particle of oxide which flakes off.

Two control measures are recommended as a result of this discovery: Hydrogen must be prevented from entering the metal, and the growth of the oxide platelets in the localized reaction sites must be inhibited by the addition of suitable alloying elements.

Manufacturing power for the '70s . . .

Increasing electrical loads, a significant portion of which will be highly variable peak loads, are forecast by Allis-Chalmers' Industrial Systems Dept for the years ahead and on into the '70s. Use of electric power on this scale will call for larger blocks of power close to metropolitan areas and will create special problems at remote plants. Transmission of power will continue to involve serious voltage and frequency variations.

With engineered systems and more automatic controls, the cost per plant will rise drastically — both in equipment and in power — and can only be offset by increases in production and quality levels. More use of controls will call for power supplies having precisely regulated frequency and voltage.

Static power converters for adjustable-frequency drives, and for control circuits using frequencies of 360 to 420 cycles, will be predominant by 1970. Continuity of service will become increasingly important as the hourly cost of downtime on these large capital investments increases.

Projecting today's rapidly expanding industrial loads is a key to the power expansion that will be needed. Plans for industrial loads should include new techniques and processes, higher speeds, greater quality control, advanced test facilities and broader plant services.

Uranium-steel ingots . . .

Atlas Steel Limited, Welland, Ontario, Canada, has successfully rolled the first heavy ingots of uranium-steel alloy and then rolled the ingots into plate. The plate is said to be living up to the previous history of tests (AM/MM—Mar 7 '60, p81) made in the laboratories of Canada's Dept of Mines and Technical Surveys.

Filament winding plastic . . .

Plastic components of electronic devices are being made by "filament winding" at Temco Electronics & Missiles Co. Although production by this "caterpillar cocoon" process is limilted at present, more applications are being sought. Filament-wound fabrications, says Temco, offer two advantage over other plastic structures: 1. Filament-wound plastic is stronger for its weight than any other known material and 2., Filament wound structures perform better than laminated-plastic structures, which they frequently replace, in electronic devices.

Almost any structure with what engineers call a "surface of revolution" can be produced by filament winding. Thus, it is most useful for making symmetrical shapes — cones, cylinders, spheres, and their variations. Spheroidal radomes, cylindrical rocket-motor cases, tail cones, cylindrical shipping containers, and storage bottles for gases are typical of the products best suited to this method. In the process, a long thread impregnated with plastic is wound around a shaped mandrel.

Magnet lab at MIT . . .

A new research laboratory to be built at Massachusetts Institute of Technology under a $9,502,000 contract from the USAF Air Research and Development Command will house the world's most powerful magnet. Created as a national research center, the new MIT Magnet Laboratory will produce extremely high and continuous magnetic fields, to help develop new knowledge about matter and energy.

With its array of generators, the laboratory will be able to produce a continuous magnetic field of 250,000 gauss. This field is more than 500 times larger than the earth's magnetic field.

JONES & LAMSON MACHINE TOOLS

the man who needs a new machine tool is already paying for it

Two-dimension tracing eliminates secondary operations and reduces costly "off" machine time

Two-dimension tracing, combined with conventional turret lathe tooling, provides an extremely versatile method for complete machining to tight specifications.

For instance, the end use of the connecting rod bolt (illustrated above) demands extremely fine finish to eliminate the starting of fatigue cracks. In addition, relief surfaces, O.D., head faces, and threaded end must all be square and concentric. Radii of fillets connecting the different diameters must be smooth and free from scratches. Two reliefs, each 6½" in length, must be held to + or — .002" and to 40-50 RMS to eliminate subsequent grinding operations. The finished parts are 19-3/4" long with different O.D.'s varying from 1-1/2" to 2-7/16". The material is tough: AISI 4140; Brinell 241.

All this is accomplished in one tooling set-up on a J&L turret lathe with a two-dimensional tracer. Floor-to-floor time for finished parts is less than three minutes on the head end, and less than nine minutes on the shank end. Write for Folder #5903.

Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

WHAT'S AHEAD... in Metalworking

TRENDS

No upturn likely before fourth quarter...

Metalworking production is holding steady through the usual summer slowdown. There are no signs of any marked increase in business until the fourth quarter. But with increased defense spending almost certain, the metalworking industry should pick up considerably.

Steel producers, meanwhile, report spotty ordering by fabricating industries, but some note that there are fewer pushbacks now than a few months ago. They are predicting an upturn of perhaps two or three points in the operating rate for August. One steel man feels there will be a sharp upturn in orders around November by industries anticipating a possible increase in steel prices in December or January.

Farm machinery builders are experiencing a very dull season. Sales are down from last year and there is little expectation of an increase. So, even though the first four months of 1960 were up 38% over last year in sales, the year will probably finish out moderately behind 1959.

Cutting tool manufacturers report business down slightly, but foresee an increase in September. One major concern expects a considerable increase in volume because of wider application of numerically controlled equipment.

Metal stampers are expecting the traditional early fourth quarter pickup, but at present seem to be in the midst of the summer slowdown that started, this year, in May. With a reasonable success of the 1961 cars, the industry should have a good year.

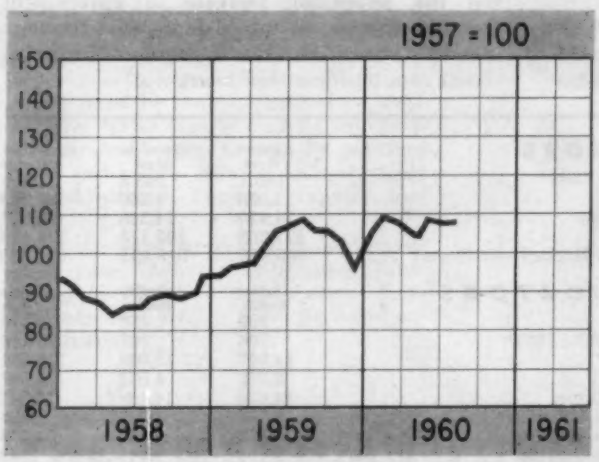
Metalworking job shops are doing steady business "on a low basis," with no apparent change in the offing. This situation is expected to hold for the remainder of the year.

Reports from furnace manufacturers put business above last year this time, with an outlook for the year to equal or slightly exceed 1959. This is in direct contradiction to the report from the Industrial Heating Equipment Association (*AM/MM*—July 25 '60, p87) on the declining sales of industrial furnaces.

Brightest spot in the metalworking picture is the continued increase in tool and die orders. The NTDMA reports an increase of 8% for the latest month, and this represents a level 29% above that at this time last year. Employment in the tool and die industry also rose to a level 11% above last year. Only disturbing factor is that re-tooling orders for the 1961 automotive model year are just about at an end, and it is far too early for 1962-model orders.

Commercial heat treaters are still in the slump that hit them in mid-April. They attribute their declining business not to any special segment of the industry, but to a general slowdown in metalworking operations. Some predict a slight pickup in August or September. If it doesn't come, this could be one of the heat treaters' worst years in recent history.

Welding shops are reporting an unusually slow season. One operator, who says this is usually a booming season for him, says that business is down to a fraction of last year's volume. These shops, too, blame poor business on a general slowdown in metalworking activity. "We haven't lost any customers, it's just that our customers aren't busy either," they say.



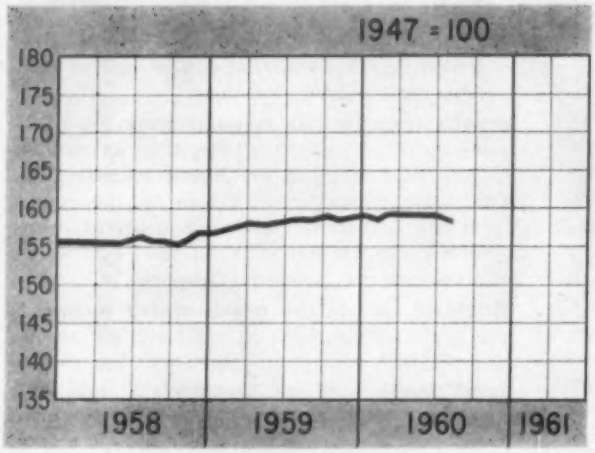
107

AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	JULY Estimated	JUNE Preliminary	MAY Revised	JUNE Year Ago
Total Index	**107**	**107**	**108**	**107**
Machinery	105	104		104
Electrical Machinery	115	115		110
Autos	120	120		113
Other Transportation	87	93		96
Other Metalworking	111	111		112

TRENDS WHAT'S AHEAD... in Business



158.7

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	JULY Estimated	JUNE Preliminary	MAY Revised	JUNE Year Ago
Total Index	**158.7**	**159.5**	**159.6**	**159.2**
Metalworking Machinery	**192.0**	**191.2**	**185.7**	
Other Machinery exc. Electrical	**172.6**	**173.0**	**171.0**	
Electrical Machinery	**160.4**	**160.2**	**160.5**	
Fabricated Metal Products	**147.7**	**147.8**	**148.8**	

The trend is still upward...

Prospects remain good for a steady upward trend in business in the months ahead. Despite some sluggishness in industrial output in recent weeks, there is still much underlying strength in the economy. And it will keep general business expanding.

This basic strength showed up in the latest report on the gross national product (the overall measure of the nation's business). Official figures indicate that GNP rose to an annual rate of $505 billion for the second quarter of 1960.

The gain for the second quarter came to only $4 billion—far less than the increase registered in the first quarter of the year. Significantly, however, the gain came despite a drop in the rate of inventory building—a key factor in the business upswing during the early months of the year.

But the strongest factor in business growth in the months ahead is likely to be a pickup in government spending. An increase in pay for federal employees has already passed through Congress over a presidential veto. And a sizeable increase in federal outlays for new highway construction is already assured. And looking farther ahead, the defense budget is likely to be increased regardless of the outcome of the presidential election.

Consumers, meanwhile, continue to spend at near-record levels. Retail sales in recent months have held close to the record set in April. And personal incomes still are on the rise.

The latest survey of consumer buying attitudes by the University of Michigan Survey Research Center indicated, however, that consumers had cut back on the buying plans they had earlier this year, and that a growing number are expecting a business downturn.

But the impending increase in government spending coming on top of high-level business spending should be able to ward off any real threat of a business slowdown.

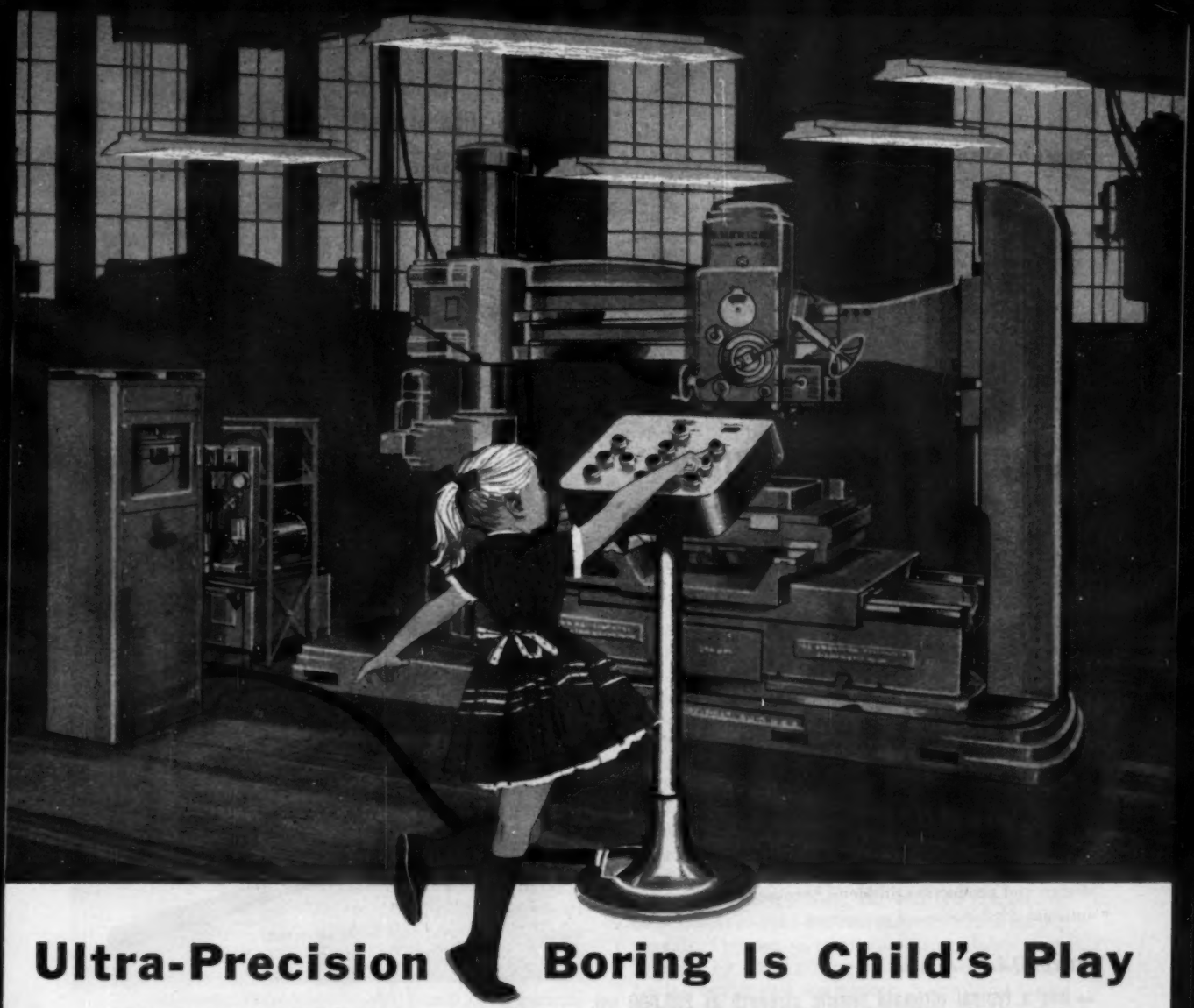
WEEKLY BUSINESS INDICATORS

	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	148.1	148.8	152.9
Steel ingot operation (thousands of tons)	1,533	1,500	345
Electric power output (million Kilowatt hours)	14,425	14,208	13,577
Production of automobiles	111,262	105,113	124,446
Engineering construction awards (Eng. News-Record—millions)	365,465	519,835	331,520

MONTHLY BUSINESS INDICATORS

	Latest Month	Preceding Month	Year Ago
Index of industrial production (1957=100)*	109	110	110
Index of durable manufactures production (1957=100)*	106	107	110
Durable goods manufacturers' sales, millions*	15,087	15,005	15,515
Machinery manufacturers' sales, millions*	4,772	4,832	4,507
Durable goods manufacturers' new orders, millions	14,626	14,469	15,241
Machinery manufacturers' new orders, millions	4,764	4,756	4,626
New Orders for Nonelectrical Machinery (1950=100)*	177	188	175
New Contracts for Industrial Construction (1950=100)*	154	141	142

* Seasonally adjusted



Ultra-Precision Boring Is Child's Play

With the new AMERICAN tape controlled Positioning Table, *everybody* can bore to ±.00025" without any possibility of error!

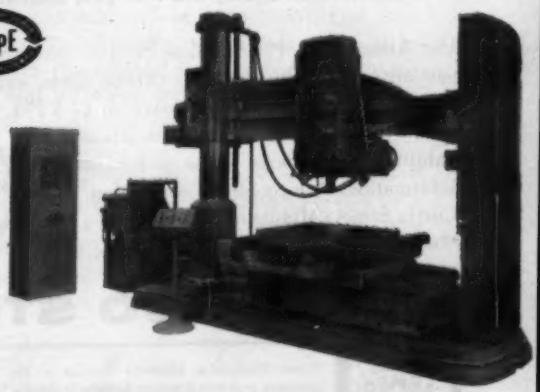
Low, low tooling costs and efficient production are child's play when you use the new American numerically controlled Positioning Table.

Designed by an American Tool Works Company/Sperry-Gyroscope team, your American ultra-precision Positioning Table is *rugged* . . . almost impervious to wear or failure. Electronic parts are protected by sealed, pressurized compartments. The Mylar tape is read by low pressure air . . . no steel fingers to tear the punched holes. Table and saddle ride on indestructible hardened and ground Timken graphite tool steel ways.

Used with the new American Hole Wizard Radial Drill, your American Positioning Table saves you up to 71% in tooling costs! Your production increases 400%! Your jig costs are entirely eliminated!

Ask your American Distributor about "Toolease", our leasing plan under which this American Positioning Table and American Hole Wizard Radial Drill combination can improve your production . . . while it pays for itself! Or, write Section 161 at the address below. Ask for Bulletins 700 and 801.

MMT-PE



THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE • CINCINNATI 2, OHIO

CIRCLE 206 READER SERVICE CARD

ARMCO STEELS for better products — lower costs

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Solve These Design and Production Problems With Armco 17-4 PH Stainless Steel

Armco 17-4 PH* Stainless Steel offers you solutions to many design and production problems because it possesses such an unusual combination of properties.

Armco 17-4 PH —

- **— has a typical ultimate tensile strength of 200,000 psi**
- **— can be hardened to Rockwell C44**
- **— resists corrosion as well as Type 302 stainless in most media**
- **— has useful mechanical properties up to 1000 F**
- **— is heat treated at only 900 F to gain maximum strength**

Use Armco 17-4 PH Stainless Steel to give *your* products new advantages. By replacing carbon steels, standard stainless grades or non-ferrous alloys with 17-4 PH, you can cut production costs and improve the life and reliability of vital parts. Write us for complete information. Armco Steel Corporation, 2350 Curtis Street, Middletown, Ohio.

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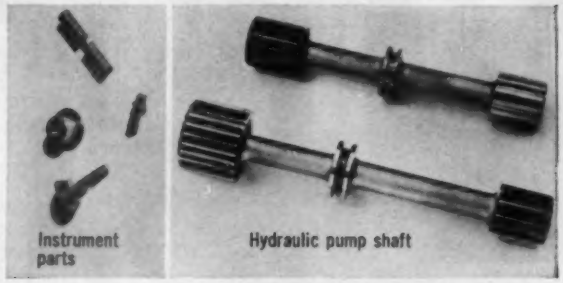
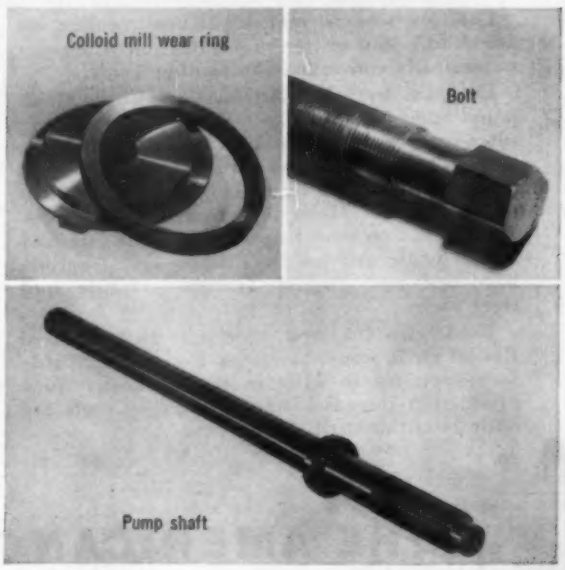
Elimination of Distortion and Scaling



High Strength Plus Corrosion Resistance

Resistance to Galling, Wear and Abrasion



American Machinist / Metalworking Manufacturing ESTABLISHED 1877

More Lasting Than the Dilly Bean

Have you heard about the dilly bean? Seems that the latest fad is to eat pickled fresh green beans, dubbed dilly beans, at martini time. The dilly bean is advertised as a threat to the peanut and the pretzel. Two gals are said to have thought up the name and idea and are busy canning dilly beans and coining profits.

How long will the dilly bean fad last? You tell me. It may fade as fast as it came into being. Again, its acceptance may be such that the name will permanently be enshrined in our dictionary and our vocabulary.

Automation came into our consciousness about as abruptly as the dilly bean. It suddenly was there. Most metalworking manufacturers felt that they had to do something about it or they were behind the times.

Some of the uses . . .

of automation were excellent, but others were pretty bad and costly. It got so that companies often invested as much money in automating a machine as the machine itself cost. The result was that some of the installations cost more money than they saved.

A reaction set in. After the first flush of enthusiasm, managements sharpened their pencils and figured out carefully how they could put automation safely and sanely and profitably to work. They found that it was not a cure-all for every high-cost production problem. It could do a lot for them, however, if applied to the right situations.

Automation thus has become an important and integral part of metalworking manufacturing. It has grown steadily and soundly in its applications and promises to continue to grow in the years ahead.

That automation is carving an ever larger niche for itself is proved by an AMERICAN MACHINIST/METALWORKING MANUFACTURING survey to be published in our August 22 issue. Almost one-fourth of 1107 plants have some kind of automated equipment at work, the survey shows. Three years ago the ratio was less than one-fifth.

Popular conception of automation is to associate it with big, high-production plants. Of special significance is the disclosure in the AM/MM survey that more than half of the plants with 500 to 999 workers have some kind of automated equipment. As recently as 1957 the ratio was 35%.

Of the plants reporting . . .

some form of automation, four out of ten have cutting-type machine tools with automatic loading and unloading devices; one out of four have presses which are loaded and unloaded automatically; almost one out of five have automatic paint lines; and 17% possess automatic assembly lines.

Other types of automation are found: transfer devices between cutting-type machine tools and between presses, automatic plating lines, in-process automatic gaging, automatic heat-treating and automatic welding lines.

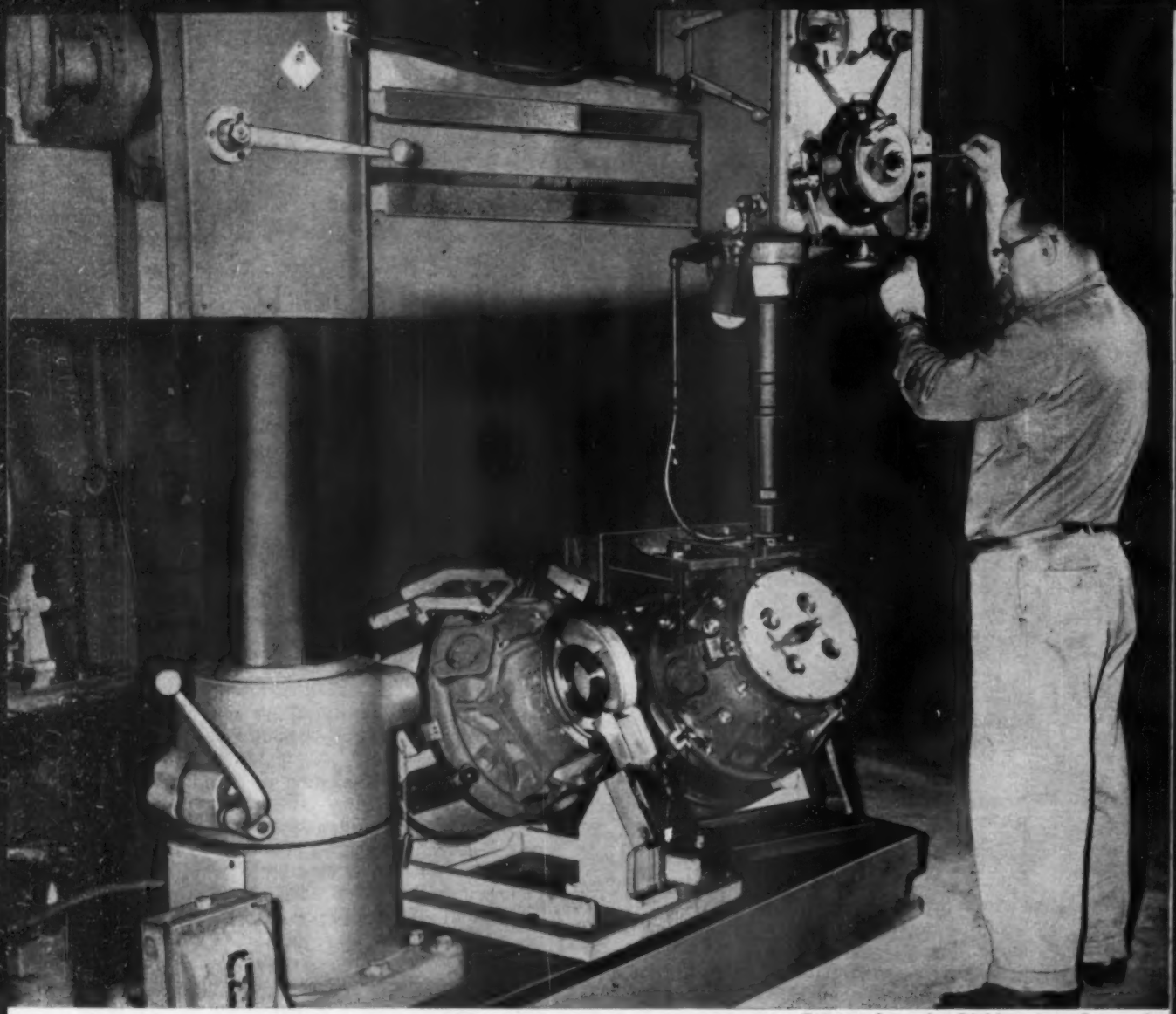
Why automate? Well, there is one compelling reason that should not cause surprise, the survey reveals. The desire to reduce direct labor costs is cited by 69% of the respondent companies having automated equipment. A corollary factor is the wish to increase output. About two out of five companies also cite improvement in the product as an important reason.

One major conclusion . . .

is clear from the three surveys that we have made on automation—in 1955, 1957 and now. After floundering when it first was a fad, automation has established itself as one of the accepted and effective tools of intelligent managements. Its use will grow rather than shrink.

If you have neglected to investigate what it can do for you, or failed to explore its full possibilities in your shop, you had better do it right away. We have a hunch that automation is going to be around a lot longer and do much more for you than the dilly bean.

Burnham Finney EDITOR



Courtesy Lycoming Division, Avco Corporation

Gilbert radial's "trouble-free" on demanding job at Lycoming

Here's another demonstration that Cincinnati Gilbert radials perform accurately and dependably on demanding jobs for demanding people.

The Lycoming Division of Avco Corporation, Stratford, Conn., uses this machine to drill, ream, countersink and counterbore inlet housings for T53 gas turbine engines. Accuracy must be within plus-minus .0005"; finish within 63 RMS.

Because of the Gilbert's versatility, three different operations can be performed with permanently-mounted fixtures. Floor to floor time per piece is about 7 minutes. Says Lycoming about this radial:

"In use on this job more than 4 years, its performance has been entirely trouble-free."

Along with Lycoming, you join a fine company of meticulous craftsmen when you acquire a Cincinnati Gilbert radial. Ask for a quotation now; our representative is listed in Sweet's.

The Cincinnati Gilbert Machine Tool Co., 3340 Beekman St., Cincinnati 23, Ohio.

Write for free bulletin

CIRCLE 208 READER SERVICE CARD

GILBERT

Air power moves this machining Skate over a mock-up of a double contour part. Vacuum cups provide track mounting

Triple-threat machining concept

"Skate"— honeycomb meets its master

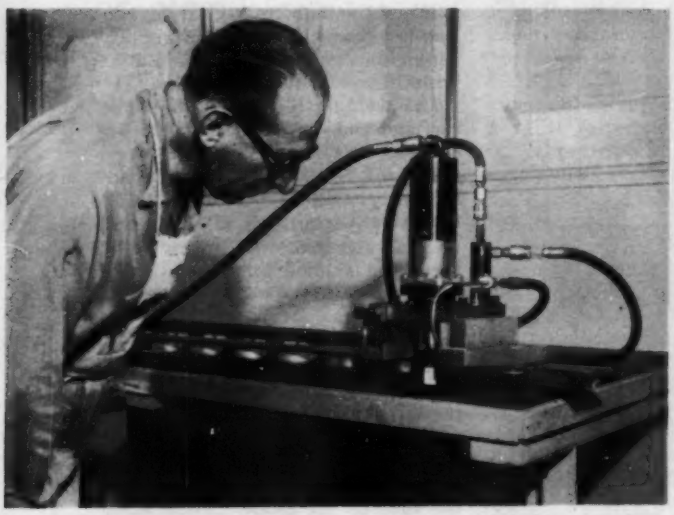
Three small tools are doing the job of three big tools at North American Aviation, Los Angeles, and they are actually exceeding the calculated output of more complex equipment.

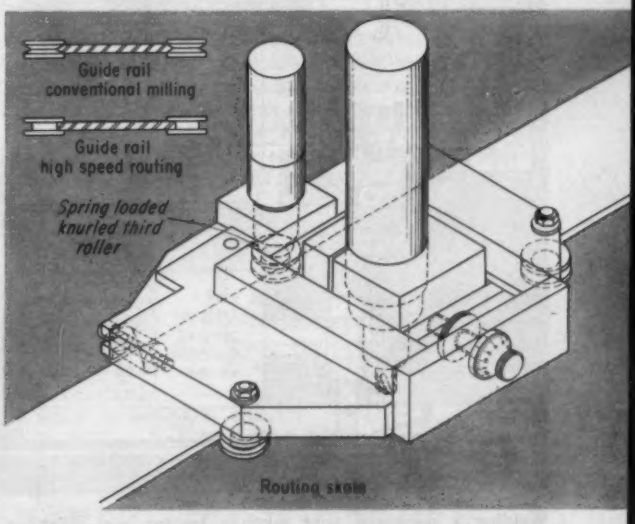
This is "Skate," a triple-threat machining concept that edge-routs, welds and x-rays large (up to 10 by 30 foot) stainless steel panels for missiles and aircraft wing, fuselage and stabilizer sections.

Actually, Skate is three separate tools—one for routing, one for welding, and one for x-raying joined honeycomb panels. The three machines can be interchanged to run on either a fixed or a portable track—"skating" along over the work, hence the name.

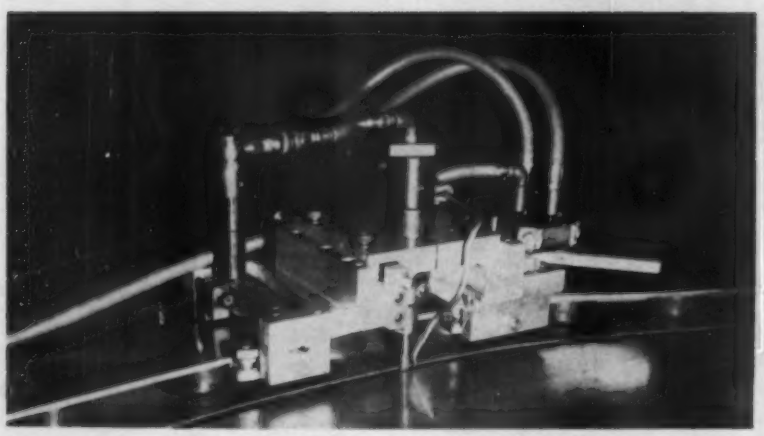
For example, one Skate routs the honeycomb panel edges for welding, is then removed from the carriage. A second Skate is substituted to weld the panel edges together. It is then removed and a third Skate is substituted to x-ray the joined panel edges.

As the machines skate along under air power, they follow a track in a ¼-inch thick, 4-inch-wide mild steel plate which is made up of sections with interlocking ends (to allow additions of extra lengths if the



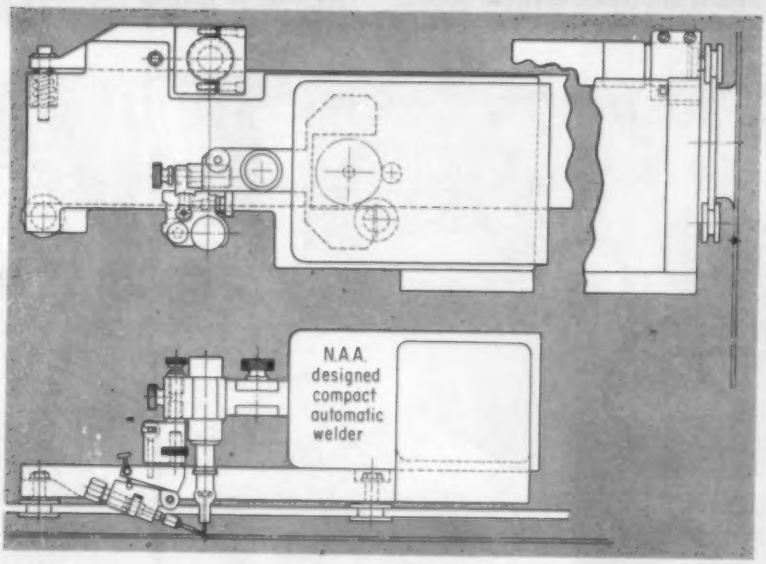


High-speed routing prepares the edge of a stainless steel honeycomb panel for butt fusion welding. Router head, or "skate" is mounted on a track fastened to the panel with Neoprene suction cups. Carbide cutters and CO_2 coolant produce excellent joint surfaces. With this method, North American machines panels up to 10x30 ft



Multi-contour machining "skate" has a double swivel motion to follow an S-curve over a contour. Here, too, the assembly is clamped to the work with suction cups

Welding with Skate . . .



Welding a machined joint involves butting and clamping a prepared sandwich against one on which the track is positioned. A weld skate replaces the machining skate and TIG welds the joined panels. A miniaturized welding head under development by North American engineers is illustrated in the sketch

honeycomb panel requires greater-than-usual tool travel). The work (honeycomb panel) is clamped into place underneath the track and the Skate.

Tracks may either be permanently fixed above a panel or, if a number of sections are to be processed, attached to the work with vacuum cups for easy removal.

In each installation, the track is positioned with optical tooling, templets, or by dimensional reference.

Routing panel edges

In preparing panel edges for welding, a router head is installed on a carriage, which rides on the track. The router is operated by a high-speed air motor(18,000 rpm), which drives an inserted-carbide four-flute end mill at 11 to 80 ipm.

This tool has been exceptionally efficient in routing heat-treated stainless, providing cutting rates beyond those achieved with larger equipment. Its friction drive, with infinitely variable and accurately controlled feed rates, is largely responsible for these results, but proper cutting speeds, liquid CO_2 coolant and good cutters also contribute to efficiency.

The air drive motor (for moving the carriage) has a step-down gear ratio of 100 to 1. Its speed output is closely controlled by a pressure regulator and a pressure gage which is calibrated in fpm and ipm.

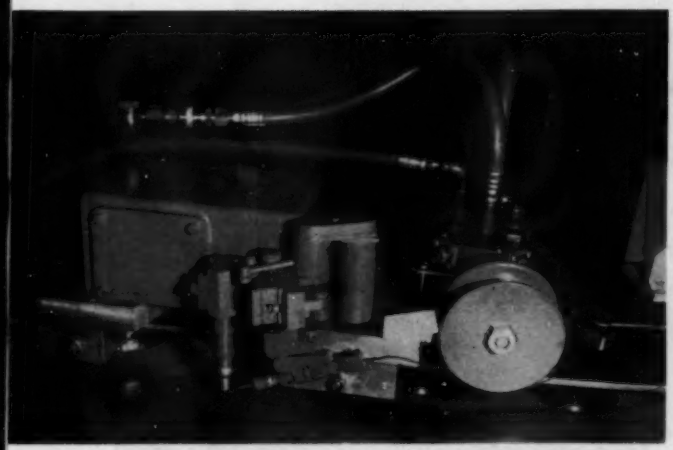
Engagement with the track is through a hardened steel roller with a fine-knurled face. The whole unit is spring-loaded for driving friction. Because of the design balance of the unit and the high cutting rate, vibration is extremely low. Thus rigidity is not as essential as it would be with heavier equipment.

The welding Skate has the same carriage and drive mechanisms. Because of its closely controlled travel speed, this Skate can be used advantageously with Tig welding heads. Other processes, such as Mig fusion welding and resistance butt welding are being studied for adaptation to Skate operation.

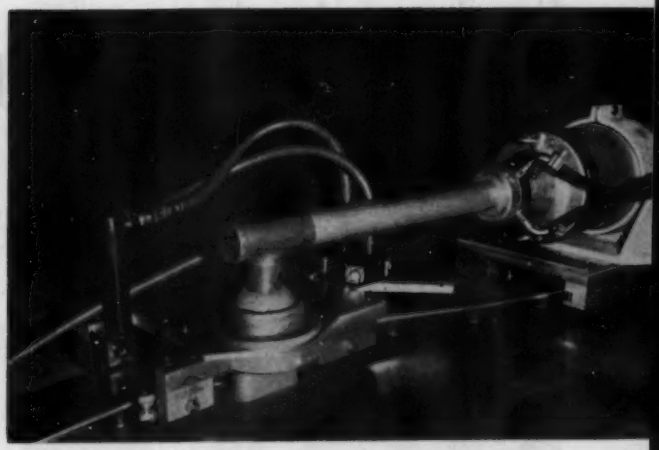
X-ray Inspection

All that is necessary to x-ray inspect a joint immediately after welding is to install a Skate unit with a 150 KCVP tube. It's as simple as that. Strip film is placed behind or under the weld, is then exposed by the tube as the Skate travels along the track.

Localized shielding permits x-ray exposure without the necessity for



Miniaturized welding head on a typical internal corner application. Attach member on the brazed panel is fusion welded to a rib beam panel and indicates the clearance requirement in this case



X-ray inspection of welded joint permits fast, accurate checking immediately after the joint is made. The X-ray skate is mounted on the same vacuum track used for machining and welding

resorting to a lead-enclosed room. Weld defects can be localized by using the exposed film strip as a tape measure, because every foot is marked by lead numbers.

More often than not, simple ideas are best—and for sheer simplicity, the Skate concept is unbeatable. With it, North American has gone a long way toward the aircraft industry's goal of cutting honeycomb manufacturing costs. Some idea of the increasing importance of honeycomb in supersonic aircraft: the B-58 Hustler uses 800 sq ft of stainless honeycomb, the B-52 1000 sq ft, and North American's Mach 3 B-70 Valkyrie bomber 20,000 sq ft.

"Hi-E" — easy way to figure optimum cutting speed

A simplified method for figuring the optimum cutting speed for any job will be explained to metalworking managements by engineers of GE's Metallurgical Products Dept (Carboloy). They will demonstrate a simple kit that will enable you to solve a problem in high-efficiency machining in a matter of minutes — by use of arithmetic.

Up till now the high-efficiency machining concept, or "HI-E," hasn't been applied widely, because of the need for complicated calculations or use of a Carboloy computor. GE has used the the method for 5 years in about 40 departments, finds that machining costs can be cut by a factor of as large as 10:1 in some cases, and now saves millions annually. Needed was some way to wrap up the essentials in a simple package that can be used by anyone.

People in the Metallurgical Products Dept got together with Dr. W W Gilbert, manager, Machining Services Dept at Schenectady, and chief spokesman for HI-E. They came up with simplified work sheets for insert or brazed carbide tools, a booklet of simple tables, and a slide rule. Without preknowledge of these materials, a group of GE shop men checked existing jobs in less than 15 minutes each. They found one heavy turning job was "right on the nose"; that another could stand a marked increase in cutting speed, in order to reduce costs.

The principles of high-efficiency machining have been explained several times in *AM/MM*. Sought is the cutting speed that will give either the lowest cost per piece or the maximum production rate. Brought together are all vital factors, such as tool life, tool costs, labor costs, overhead. Increasing the cutting speed shortens tool life. HI-E seeks to find how much tool life can be shortened economically, to make more goods in less time.

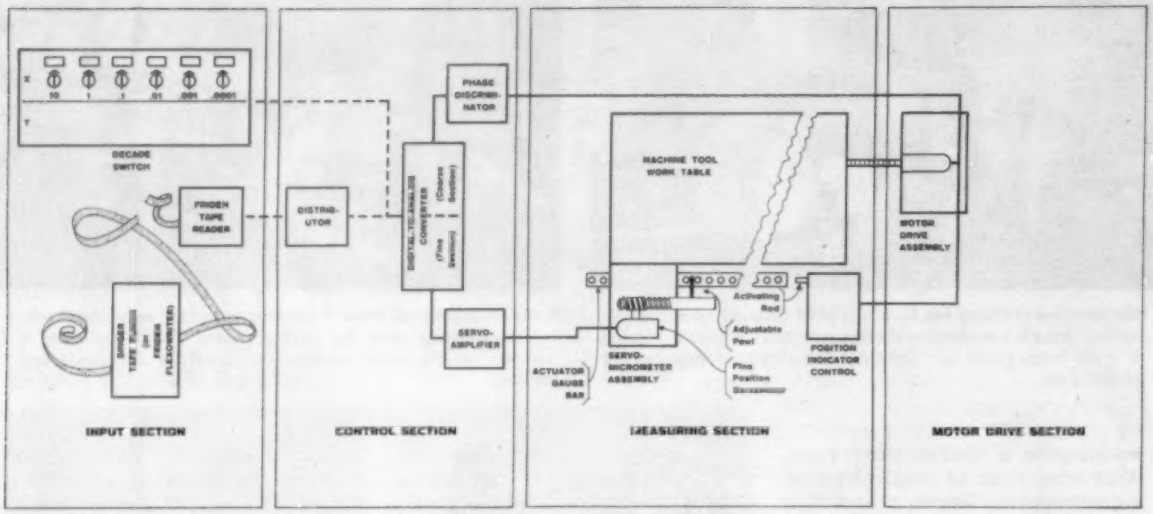
In making a calculation with the kit, five steps are involved. Suppose you are working with an insert-type toolholder: Step 1 involves entering known quantities; price of insert plus toolholder depreciation, number of edges you actually get from experience, operator's rate, overhead rate and tool changing time. Step 2 involves simple conversions of these values. Step 3 requires a simple multiplication and division to solve the tool life for minimum part cost. Or you can calculate tool life for maximum production rate in Step 4 if you are under pressure to get the job out in a hurry. In Step 5, you convert tool-life figures to cutting speed by use of the slide rule. All of the information you need will be at your fingertips or available from accounting.

The slide rule enables you to figure additional matters—you can get the work rpm for desired cutting speed, time for a given length of cut, feed of multiple-tooth tools in ipm and ipt.

The HI-E kit will be distributed free to metalworking managements and its use explained by district offices of GE's Metallurgical Products Dept, or information can be obtained by addressing the Department at Detroit 32, Mich.

Singer's control goal:

General-purpose numerical



Key to accuracy in this simple system is separation of input and control section from measuring section. Latter is electromechanical; depends upon precision gage bar and servomicrometer. All control measuring devices and motors are designed and built by Diehl Manufacturing Co, a subsidiary of The Singer Manufacturing Co.

Singer Manufacturing Company learned a lot about automatic programming many years ago—for commercial sewing machines. Another thing it learned in the textile equipment field is that an economical price yields a large market. Now this know-how has been put to work in the metalworking industry, in a machine-tool control system to be sold only through machine-tool builders. Here's how it works.

A simple, straight-forward design by the Diehl Manufacturing Co, a subsidiary of The Singer Manufacturing Co, provides a low-cost numerical-control system of significant performance. Using a combination of modular units, the basic electromechanical system accurate to ± 0.001 in. in 40 inches of travel will sell for $8750. This price includes two numerically positioned axes plus control of the basic tool functions.

3 feed rates

The system is sold as a package, complete and ready for installation including the tape reader, power supply, etc. It requires only the measuring bars to suit the specific installation and will provide either 30, 60, or 130 ipm table feed. Its console is a standard NEMA No. 1 closure.

At a new showroom in the Diehl-Finderne plant, Somerville, NJ, seven machine tools are being equipped with the new control systems. These machines include a Fosdick No. 30 jig borer, an Atlantic jig borer, a Gisholt 1-L turret lathe, a Wade Model 94 lathe, a Fosdick 5BM drillpress, a Cincinnati Model 1B Shopmaster, and a Veet radial drill—which has been converted to a gantry machine. The showroom will be used for development and training courses, as well as for operating demonstrations.

First of the machine tools to be equipped with the Singer system was the Atlantic Machine Tool Works jig borer. While the accuracy claimed for the system is only ± 0.001 in., positioning of a variety of parts on this machine has consistently been within ± 0.0002 in. Electrical accuracy of the system is 0.000025 in. This combination provides a numerical positioning two-axis jig borer for about $17,000.

Measuring system separate

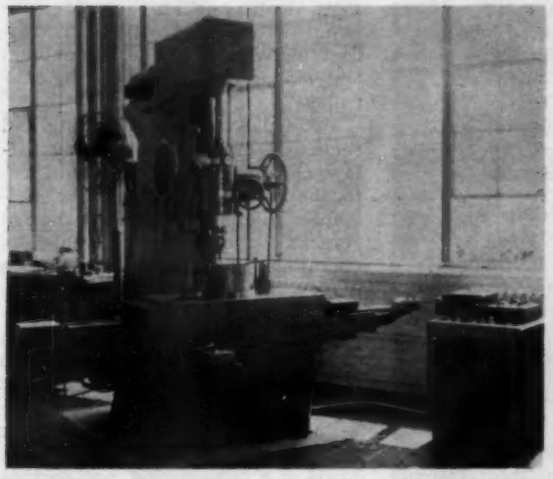
Separation of the actuating system from the measuring system is said to be the key to the system's accuracy. Two basic functional sections, data processing and response mechanism, constitute the positioning control system. Data processing establishes, by tape command, decade switch input, or punched card, an analog signal proportional to the machine motion from a fixed reference point (Zero point).

Basically analog system

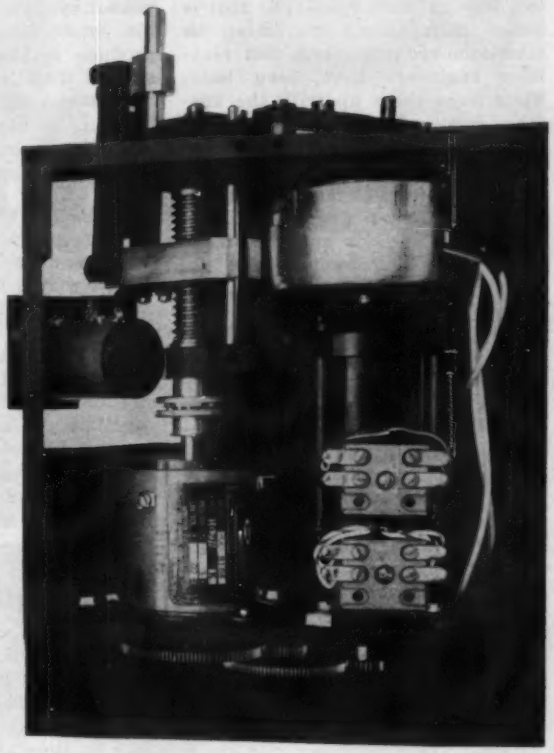
Machine motion proportional to the analog signal output of the data processing system is established by the response mechanism. Basically, this mechanism is a 60-cycle, a c, closed servo loop having a linear feedback potentiometer, geared to the motion, which transmits a feedback signal proportional to the position of the motion from a fixed reference point.

In a bridge circuit, the analog output of the data processing section is compared with the feedback signal and the difference between them is an error signal, which drives the

positioning at low cost



Applied to this Atlantic jig borer, the Singer numerical positioning system consistently repeats to ±0.0002 in., although accuracy claimed for it is only ±0.001 in. Machine plus control system sells for around $17,000. Chart is supplied to permit correcting sensitivity of control to suit weight of work on table.



Servomicrometer assembly provides decimal fraction positioning for fine control in relation to one-inch spacing on coarse-positioning bar. Micrometer screw does not carry any part of actual work load

response mechanism to null-balance with every change of input information.

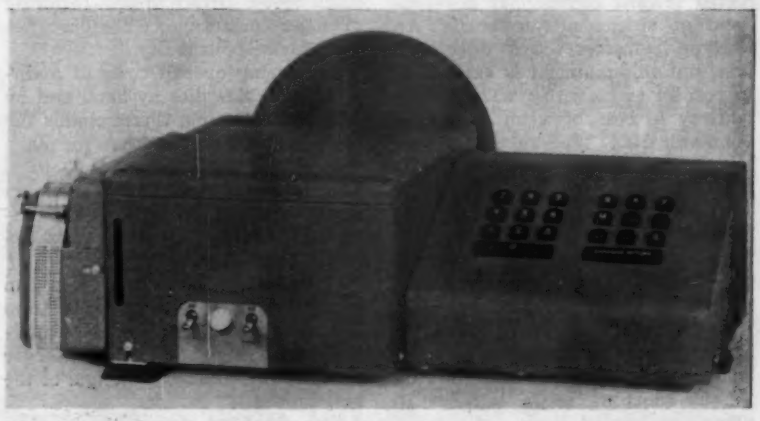
Actual motion is supplied by a motorized gear-driven actuator in a multi-speed system. The high-speed stage, for rapid traverse, operates through a conventional gear train. Lower speeds direct the machine motion to final positioning.

Electromechanical micrometer

At present, three separate drives are available to provide three speeds: 30 ipm, 60 ipm and 130 ipm. The latter speed is infinitely adjustable down to ½ ipm. Final approach speed is 0.015 in per sec. and the fine control operates at this speed from 0.008 to 0.015 in. away, to the final position. Average positioning cycle is 3 to 10 seconds, depending upon the length and complexity of the path traveled.

Fine positioning is provided by a special electromechanical micrometer system. It consists of three units: An accurate gage bar with stops precisely located every inch along its length; the servomicrometer assembly, which engages a specific stop to achieve a point location; and the position indicating control, which locates the final position to the accuracy and repeatability described.

All data required for the various positioning functions are programmed on eight-channel, one-in-wide tape by the Singer tape punch or a Friden Flexowriter typewriter and are read into the system by a Friden tape reader. Decade switch input is provided to permit manual input and/or to over-ride the tape input, if the operator requires it.



Simplified tape punch, developed by Singer, is less expensive and easier to use than Friden Flexowriter. However, this device does not provide all of the abilities and functions of the Flexowriter

New refractory may revolutionize production of aluminum

Until now, nobody has been able to come up with a material that is better than carbon for lining an aluminum-reduction cell. But ceramics engineers have been busy. They have come up with the answer — one that opens up big possibilities for making aluminum at less cost. Other fruits of this research are: furnace muffles that will permit complete shut-off of fuel during idle periods and the likelihood of feeding molten metal to diecasting machines from a central melting furnace and pump.

Right now, four major aluminum producers are testing aluminum cells in which the carbon lining is replaced by a thin wall of a new type of refractory. The results so far indicate that a significant breakthrough has been realized. Power costs may be reduced 15% Other benefits are the possibility of entirely new cell designs that will be more productive per unit, virtually wearproof, and capable of higher quality production.

To date, the production of virgin aluminum is a batch process. Engineers foresee the day that an Italian continuous process will be made feasible by the new refractory.

Why it was developed

Development of the refractory—Crystolon 63—was undertaken by Norton Co, Worcester, Mass, after it was found several years ago that silicon carbide had good potential as sidewalls in aluminum cells. The standard oxide or clay bond was unsuitable, and so attention was directed toward commercial development of silicon nitride bonds. An N type refractory was developed first, but this material is expensive. In respect to cost, the "63" is about midway in cost between an oxide-bond and the N type but it is an entirely new material and so is being patented.

The properties of "Crystolon 63" suggest that it will be a cost-saver for shops using muffle-type hardening furnaces. Heat conductivity and resistance to thermal shock are high. An owner of a furnace equipped with a muffle made of this material could shut it down at night and start up in the morning again without ill effects or loss of time.

Molten aluminum, zinc, magnesium, lead and other non-ferrous metals do not wet or stick to the new refractory. Severe flame inpingement for considerable periods does not produce erosion. These properties suggest that Crystolon 63 will have important uses in the remelting of non-ferrous materials and production of alloys, and very likely in die-casting procedures.

Dangers of metal pickup

Metal pickup by erosion of refractory materials or linings is a serious matter because stringent demands are being made for greater purity of non-ferrous metals and their alloys. Therefore, it is expected that the refractory will be used in metal transport and furnace auxiliaries. Under discussion is a low-head, large-volume pump of the piston type, wherein the refractory would be used as a lining or facing material. It will be necessary to machine the parts with diamond tools. Later on, higher pressure pumps will be designed for centralized delivery of molten aluminum and magnesium to die-casting machines.

Metal pickup during melting and remelting of these non-ferrous alloys can have serious consequences to the metal-parts fabricator. Example: an aluminum hubcap showed "cracks" after the final finishing operation. By expenditure of much money, the cause was traced to pick-up of calcium compounds from metal-delivery equipment applied to a furnace. The compound was worked into the metal much like stringers and eventually fell out at final polishing, leaving the "cracks." If the metal-delivery system had been made of a non-wetting, non-corrodible refractory, the hubcap metal would have been sound.

Diamond belts cut die-polishing costs

Hand polishing of large carbide drawing dies has been replaced by a diamond belt method at Chase Brass & Copper at spectacular savings in time and overall costs. Not only that, accuracies and surface finishes are much higher.

According to the Chase people, die-polishing jobs that formerly required 2 to 6 hours by hand can now be done in as little as 15 minutes. More accuracy is achieved in removing predetermined amounts of carbide from the dies, and dies have a much better surface finish—resulting in loger performance before dies must be re-polished.

Comparing overall costs of maintaining carbide dies by hand and by diamond polishing, Chase claims the belt method is cheaper than the manual method by a ratio of 50 to 1. This takes into account man-hours saved, cost of materials, and increased service life of the dies between polishing operations.

Chase's diamond belt polisher can service carbide dies of sizes from ⅜ inch to 8 inches diameter—removing wear rings, opening to larger sizes, and reshaping the angle of the bell mouth.

The machine drives the endless belt at 5000 sfpm. Chase has belts in three widths, ranging from 3/16 to ⅜ inches, in a number of grit sizes. Belts are impregnated with 100, 200 or 300 mesh natural diamond grits, and are cooled with water during operation.

Chase engineers are not certain as to the average life of diamond belts, because of the difference in amount of carbide removed in each die polishing job . . . but up to 200 dies have been serviced by a single belt.

Tungsten-tipped tool regulates belt angle. Belt polishes the die parallel with the line of draw of work through the die

If you build a better toolroom...

A toolroom should be laid out so that the toolmakers' benches are centrally located, and the central area should also include the general-purpose machines that are most frequently used. Then, if you group the heavy machines, the cutting machines, the grinders, and the heat-treating equipment in their own areas around the toolmakers' area, the necessary trips to this other equipment will be short and direct.

That idea, along with a layout showing the areas and the machines, won $250 for L M van Tetterrode of Northern Electric Co, St Lambert, Quebec, in the Better Toolroom Contest sponsored by AMERICAN MACHINIST/METALWORKING MANUFACTURING at the Detroit Tool Show.

A three-dimensional model displayed in the *AM/MM* booth at the show portrayed a toolroom designed to serve a hypothetical plant engaged in manufacturing home appliances. The contest was intended to stimulate suggestions for improving the efficiency of the shop.

Second-place winner, William S Mazar of General Precision Inc, Binghamton, NY, won $150 with a suggestion similar to van Tetterrode's. He called it the "Square Wheel Plan" and explained that the most frequented areas would be located at the hub of activity.

A Munzenberger of Ford Motor Co, Detroit, third-prize winner, was disturbed about material handling and the distance that sheet metal would have to travel through the shop as it was originally laid out. He won $100 with his suggestion that the sheet-metal department be moved adjacent to stores.

C W Holmberg

S K Rudorf

R I Michalak

Model toolroom display, offering prizes to anyone who could design a better one, drew interested spectators, critics, and contestants to the AM/MM booth at the Tool Show in Detroit. Below: industry experts who judged the contest

The judges

Judging the contest were three men who represent a collection of real toolroom talent. All of them have spent most of their lives in and around toolrooms and are now occupying important positions.

S K Rudorf, after coming to the U S from Germany, served an apprenticeship as a draftsman-tool designer at Allis-Chalmers Manufacturing Co in Milwaukee. During his 16 years with that company he held such titles as chief tool engineer, superintendent of maintenance and tooling, and manager of tool design.

Seven years ago he went to A O Smith as assistant to the vice president, manufacturing. At present he is manager of the Special Products and Tool Manufacturing Division, which is essentially a king-size toolroom, employing about 500 people.

Ralph I Michalak, a veteran of 25 years in metalworking, has worked as a tool and die maker, a methods engineer, and a tool engineer at The Toledo Scale Co and at the Packard Motor Car Co's Jet Engine Div. For the past 9 years he has been with Westinghouse Electric Corp's Electric Appliance Division where he is now acting superintendent of the tool division.

Centre W Holmberg, president of August W Holmberg & Co, Inc, received a mechanical engineering degree from Pennsylvania State College in 1917. Then he worked for Sperry Gyroscope Co, the Army, and the De La Vergne Machine Co before entering his father's shop in 1919. He took over management of August W Holmberg & Co in 1928.

Active in tool and die societies, Mr Holmberg is a past president of both the New York Tool & Die Institute and the National Tool & Die Manufacturers Association.

These men judged the contest entries on the basis of both the merit of the suggested improvements and the manner in which they were presented but it should be emphasized that winners were determined by combined vote. The three-dimensional toolroom layout that served as the starting point for the contestants was designed by the editors of *AM/MM* in collaboration with Lester B Knight Associates.

At the Machine Tool Exposition in Chicago, the model toolroom will be on display again in the *AM/MM* booth. There it will be joined by another three-dimensional shop layout of a well-equipped job shop.

Turret lathe positions, contours

Trace without templets, press the button and let 'er run like an automatic, turn and contour with the same cutting tool, set up profitably for a few pieces—These are only a few of the benefits you'll have in tomorrow's turret lathes, typified today by the Factrol 101.

Special tooling is minimized on the Factrol 101 because it offers both positioning and continuous-path control. Thus a single-point, tracer-type cutting tool can perform most of the turning, facing and chamfering operations. Only drill, reamers, taps, parting tools, etc, need be changed from job to job. All controls are mounted on machine itself. There is no separate console

Continuous-path control, for contouring, on two separate tool systems plus all of the essential controls needed fflor turret lathe operation, makes the new Gisholt Model 101 Factrol must viewing at the Chicago Machine Tool Exposition. The design, which puts all of this control in a single package, mounted on the automatic turret lathe, is an ingenious example of condensation. In a sense, the numerical-control concept applied to this turret lathe makes it a single-spindle automatic suitable for short runs.

What tape control does

Automatic cycle control for this machine is directed by information recorded on 2½-in.-wide magnetic-oxide mylar tape. This tape control provides:

- Selection of one of six tool positions of an automatic indexing, cross-feeding hexagon turret having 8 in. of cross travel and 38 in. of longitudinal travel.
- Selection of one of four tool positions of an automatic indexing tool post on a universal full-swing side carriage with 11 in. of cross travel and 38 in. of longitudinal travel.
- Selection of one of 24 spindle speeds in a range from 18 to 1090 RPM.
- Continuous-path, position, and rate control of both turret and toolpost for simultaneous straight, taper, or contour turning, boring, or facing at lo.gitudinal feed rates infinitely selectable from 0 to 20 inches per minute and transversely from 0 to 10 ipm.
- Coolant flow control to each tool while cutting.

The simple, tape-recording method for this machine permits direct and instantaneous recording of chamfers of any angle, and corner rounds from 0.025 to 100 in. radius. As a result, tool setup is simplified and the number of tools required to do a job is greatly reduced. Chamfers and radii are quickly and accurately generated with the same tools used for turning or facing and in a continuous cut. Time is saved because it is not necessary, as with rectilinear positioning systems, to retract the slide, index the chamfer or radius tool into cutting position and advance it to the cut.

Cutting index travel time

Automatic power indexing of the turret and toolpost can be programmed to occur as soon as the tools are in the clear. This saving, combined with carriage traverse rates up to 100 ipm, minimizes index travel time. Both the four-position toolpost and the hexagon turret can be indexed in either direction. Controls are so arranged that the next tool called for by the tape is brought into position by indexing *in whichever direction* requires the least amount of rotation.

Where the amount of stock to be removed is too much for one cut, successive cuts are easily programmed. If the amount of stock is variable because of casting or forging draft, or when machining step diameters, tapers or irregular contours, the first cuts can be programmed to leave a uniform amount of stock for the finish cut.

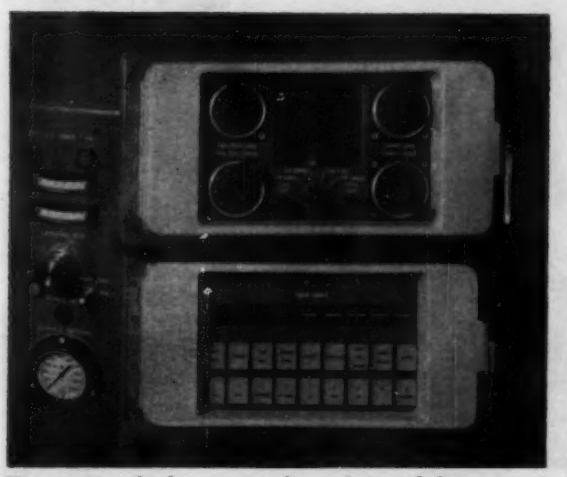
Auxiliary function commands can be read from the tape and stored while the tools are cutting, thus eliminating lost time for tape reading between cuts. Also, spindle speeds and feed rates can be changed during a cut.

Power for slide movements and for turret and toolpost indexing is provided through hydraulic units which are protected by over-pressure devices to stop movement before forces exceed safe values. All indexes are electrically monitored so that a cycle will not proceed if an index is not completed to the tool-face called for by the tape. A safety circuit in operation at all times observes the amount of error signal in each direction. If the distance between the point at which a tool should be and its actual location at any instant exceeds a safe amount, the cycle will automatically stop.

Easty to maintain

Maintenance problems are minimized. The control system consists of plug-in modules built with ex-

under numerical control



Four-position knob on control panel (just below viewer) selects motion to be displayed on drum. Knob is shown in TP Long, position, hence numbers 85, 86, 87, which appear on drum, indicate 0.085, 0.086, 0.087 in. of toolpost longitudinal travel from zero position. Turning the upper-left-hand dial, for example, will cause toolpost carriage to move and figures on drum to change accordingly

Recording unit for magnetic-tape preparation is designed to record functions by putting them in as they are put into machine manually. Right-hand vertical panel has two identical sets of tool movement selector dials—one each for toolpost and turret. This turret lathe can be operated manually under numerical control or completely programmed away from the machine

tremely reliable static-control elements. These solid-state electronic components (no vacuum tubes) are generally considered to have exceptional life. They are further protected against environmental conditions by housing them in a dust-tight enclosure with built-in air conditioning to maintain a moderate temperature and low humidity. Defective modules can be removed and a replacement plugged in. Modules are immediately available by air-mail from Gisholt. Spares can be kept on hand by the user.

How a movement is taped

On the tape-preparation console are two identical sets of tool movement selector dials, one for the toolpost and one for the turret. In front of each is a keyboard. To tape a movement, the operator presses the numbered buttons in the left half of one keyboard corresponding to the distance to be removed in the longitudinal direction. If stimultaneous cross movement is required he also presses the numbered buttons in the right half of that keyboard corresponding to the distance to be moved in the cross direction.

Having selected the rate of travel and the angle (if simultaneous movement is required) he presses the "record" key, tape drive begins and the motion is recorded, including safe automatic acceleration to the selected rate (whether feed or traverse) and automatic deceleration to zero as the end of the travel set up on the keyboards is reached. As each movement is recorded, the end points reached as recorded on counters must check with the information on the tabulated operation sheet from which the recording is made.

Preparing the tape

The tape recording can be prepared from the operation sheet by the average person with little training.

For simultaneous turret and toolpost movements, the distances to be moved by each tool in each direction are introduced into each of the four keyboards, and directions and rates of travel are set up on the dials. As feed rate is partially a function of tape speed, the feed rates of the toolpost and turret must be similar. Normally a tape speed rate corresponding to the greater of the two feed rates is selected and a portion of that rate is used for the slower movement.

Tool path radius selector

In the upper right hand corner of the two panels are the "tool path radius" selector dials which are used to record the generation of corner rounds. Assuming a 0.100 in. radius is to be generated by a turret tool, the dial is turned until the reading 0.100 in. appears. The direction of the generating movement is selected by the small dial, and when the tool movement is recorded within 0.100" of the end of a bore or face the XI button is pressed. The unit will then program the recording of longitudinal and cross movements in exactly the proper manner to result in tool movement in a 0.100 in. radius arc.

Built-in power indexing

Both the toolpost and the turret unit have built-in power indexing, for movement in two directions, for transmitting coolant to the active tool point, and for pick-up and transmission of electrical signals to indicate position, rate of travel and acceleration, yet no flexible wires, tubes, conduits etc, are visible.

Telescopic covering of lines

A multiple manifolding structure combined with a unique system of telescopic covering of air, coolant, hydraulic and electrical lines is responsible for the clean appearance of the machine.

Complete instrument gaging—Cessna has a complete set of air gages for each close-tolerance operation. When a setup is to be changed, the operators get proper "gaging stations" from storage and roll the units to their machines

Roll in the gaging stations!

When a job is changed, machine operator gets a portable cabinet containing a complete pre-engineered set of air gages and masters for setting up the machine and spotchecking production, either on a 100% or a sampling basis

"Goodparts guarantee"—operators first use their gaging stations to check machine setups, later spot check their production

Accuracy has taken to wheels at Cessna Aircraft's Industrial Products Division, Hutchinson, Kansas, where 35 portable gaging "stations" are available for on-the-spot checking of machine setups and parts during production runs.

These portable cabinets average 12 air-gaging columns apiece, to control as many dimensions. In all, more than 100 different gaging setups and instruments are available.

With them, Cessna has been able to cut down steadily on gaging costs, reducing the number of floor inspectors from time to time. Sample inspection of 1% has replaced many 100% inspections and full-time floor inspections.

Gaging cabinets such as these represent a relatively new idea for providing at-the-site instrument gaging for close-tolerance work. At Cessna, the products are hydraulic pumps, valves and cylinders for activating farm equipment and road-building machinery. Tolerances for machining and grinding are less than 0.001 in. —and many dimensions and relationships must be held to 0.0003 or 0.0005 in.

Such tolerances are deemed essen-

tial in the manufacture of components that are completely interchangeable—not only to achieve desired product quality, but to minimize inventory, replacement and assembly problems.

For this resaon, complete instrument gaging has been provided to machine operators ever since the Hutchinson plant began operations. The men check their own machine setups and parts during production runs, and the inspection operation is written into each job classification on an indirect payment basis.

Training of operators to handle the multiple-column air gages has not been a problem—new personnel are trained by an instructor, or by veteran machine operators.

Sufficient control is retained by the inspection department to prevent progressive deterioration of quality, which might naturally result from having Production responsible for most inspection procedures. This danger is further minimized by having operators set up their own machines with the gages, then holding them personally responsible for the quality of work produced.

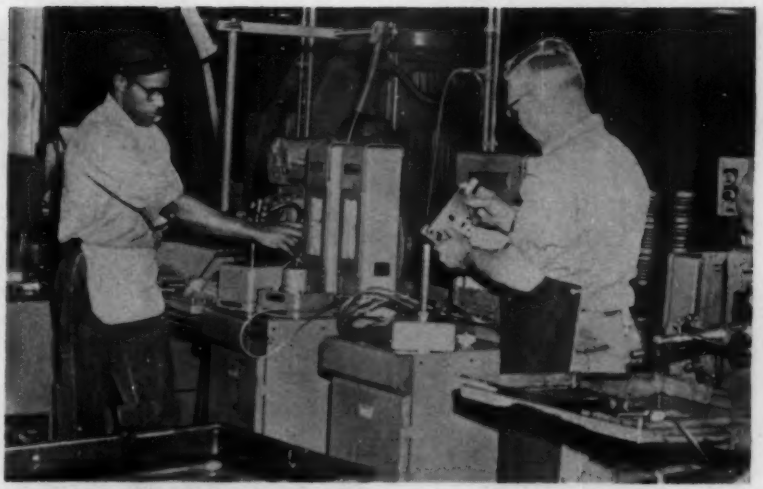
To some extent, machine selection has been influenced by gaging equipment. In one case, gages helped indicate that a certain machine was incapable of handling the heavy job its vendor claimed it could—but that it would be good for lighter work.

What does all this cost? Overall, the cost of complete instrument gaging for close-tolerance work is about 10% of the cost of production equipment installed in the plant. On certain critical operations (such as Cessna's pump production), investment for gaging equipment equals machine tool investment. But Cessna claims it would be impossible to build high-quality pumps to required close tolerances without such gaging equipment.

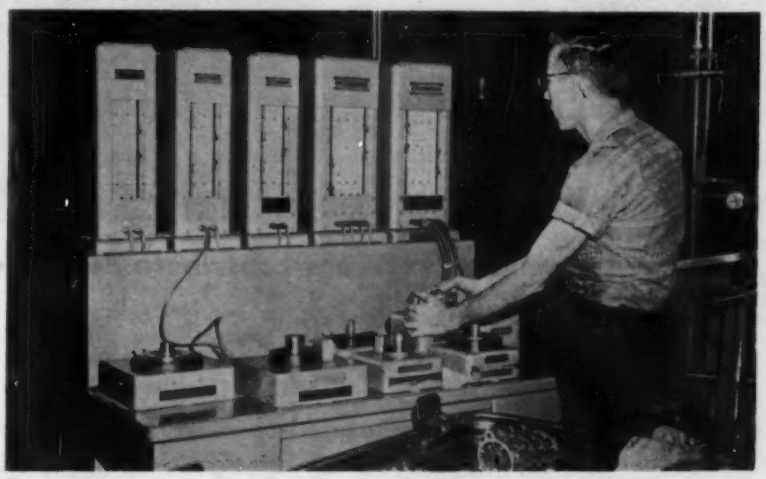
Evidently, Cessna management's beliefs and practices pay off—the company has just dedicated a new 100% addition to the Hutchinson plant, because of business growth.

The concept of portable gaging stations fitted with multiple-column air gages was developed several years ago by Sheffield Corp, Dayton, Ohio. The principle behind this concept is to supply adequate gaging as part of the tooling, and the most convenient way to do this is to install a pre-engineered setup (gaging station) for each operation.

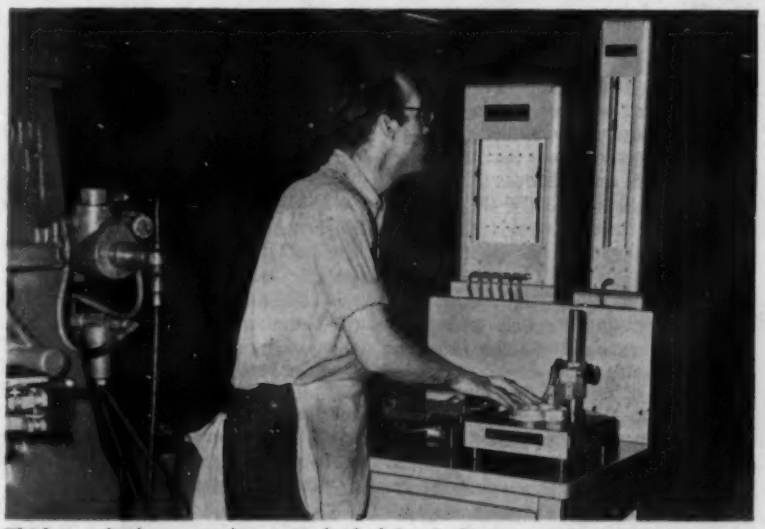
When it is no longer needed for a particular job, the gaging station is put back into storage, and another is rolled in for the next run.



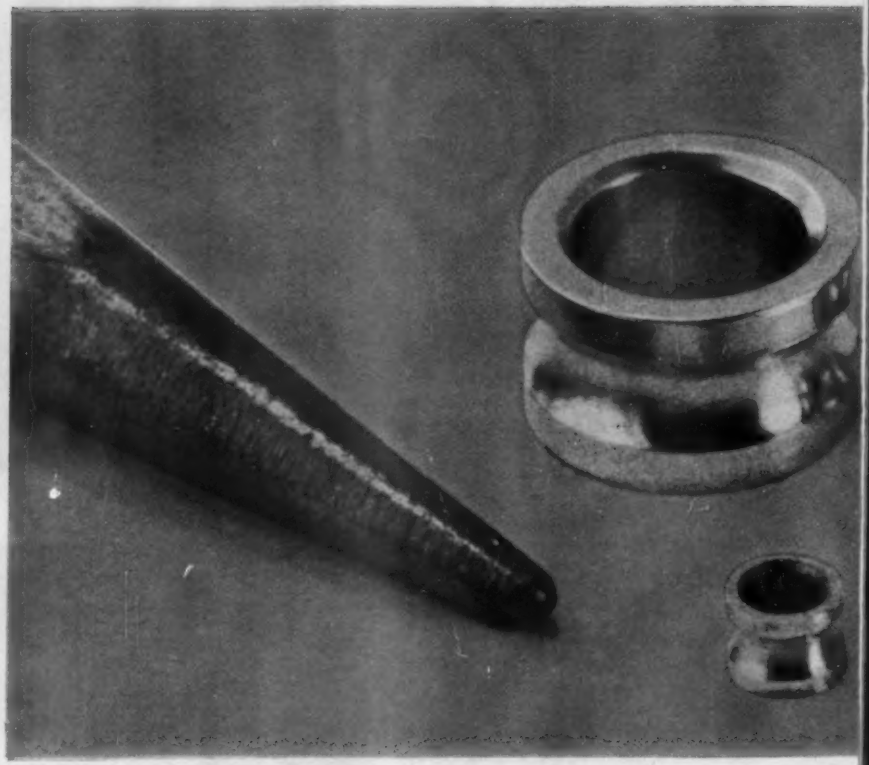
Qualifying check—air gages are used for operations with tolerances of 0.001 in. or less and to qualify diecastings



Progressive gaging—front pump plate is checked for (1) squareness and diameter, (2) and (3) concentricity front and back, (4) size and squareness, and (5) squareness



Thickness check—pump plates are checked for thickness to within 0.0005 in., using matched Plunget gaging cartridges



Tiny bearing races (right) are the product of the first machine (above) specifically designed to grind the inner ball groove on miniature bearing races. Following suggestions from the bearing industry, builder kept machine small, eliminated complex systems, and simplified setup and tooling arrangements. Machine will hold tolerances on work to less than 50 millionths of an inch, with a 3-to-4 mu-in. finish

Eight bearing manufacturers contribute design ideas on . . .

GRINDING MINIATURE BEARING

Before building a new machine to grind miniature bearing races, a machine tool company collaborated with eight bearing plants, who contributed design ideas that paid off in a better machine

By Tom Johnson, associate editor

Not much larger than the point of a pencil, the smallest of the bearing races reproduced above are the kind of precision component that the space age demands and—thanks to modern machine tools—gets. On this miniature inner bearing race (OD—0.062 in.), the ball groove has been ground to a size of only 0.039 in., among the smallest now being produced.

As one might suspect, tolerances must be very close: In the grinding operation, size is held to within 50-millionths of an inch. Such precision exceeds the Class 7 ABEC (American Bearing Engineers Code) accuracy of the entire bearing assembly.

Here the machining was done on the first machine tool specifically designed to grind the inner ball groove on miniature bearing races. Completely new, the unit is not simply a modification of an existing machine. For the past six months a pilot model has been doing actual work, to customer specifications, at the Springfield, Mass plant of the builder, Van Norman Machine Co. The machine, which Van Norman calls its 1-M Lectro-Cam miniature race grinder, will be introduced formally at the forthcoming Chicago Exposition.

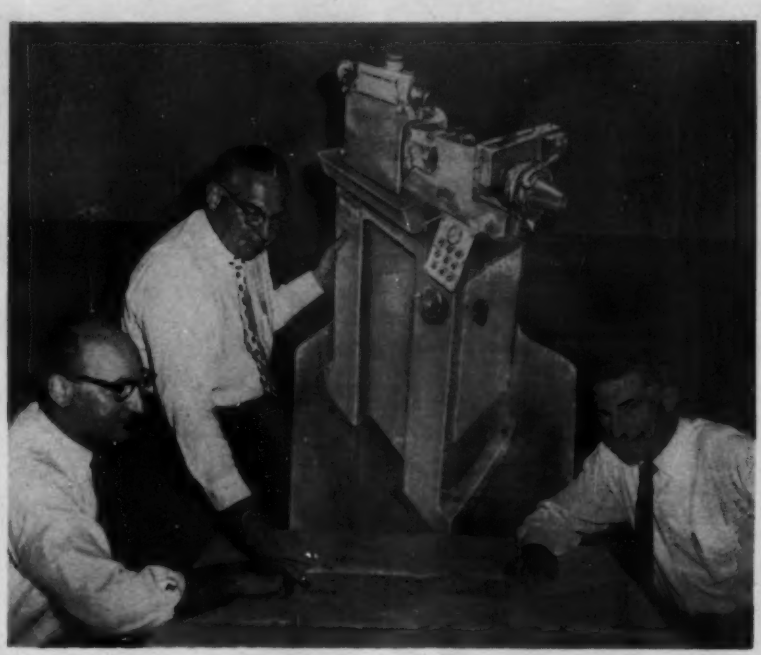
A plunge-cut grinder, the new machine achieves its accuracy with a Van Norman development called the Lectro-Cam. Under an automatic cycle, a master cam precisely controls rapid traverse, fine feed, and grinding-wheel retraction.

No stranger to the bearing industry, Van Norman realized that its new machine must be quite different from its conventional grinders. For years the bearing industry has used the company's standard machines (oscillating-radius type) to produce normal-size bearing components. But in miniature bearing assemblies, the normal problems are intensified —problems of surface finish, track contour, and accuracy. With plunge-cut grinding, and with fresh design approaches, the company feels it has solved these problems.

The market for such precision miniature grinding machines will continue to grow, Van Norman thinks. Increasingly, missile designers are asking for frictionless bearings that can wtihstand impact shock better than jeweled bearings. And the smaller and faster modern instruments become, the greater the need for more accurate, rugged miniature bearing assemblies.

Integrated industry design

The machine is unique, but so is the story behind its development. It is the first product of what Van Norman calls its Integrated Industry



Final artist's conception of machine is a refinement of preliminary sketches submitted to the bearing industry for constructive criticism. Here Van Norman executives George P Burns (vice pres, sales), Francis P Healy (vice pres and chief engineer), and Paul W Leming (president) check final sketch of their "industry integrated design" machine

RACES

Design Program—a full-fledged, formal collaboration between the machine builder and his customers. What the company did, *before* it designed the machine, was conduct a lengthy survey that revealed exactly what kind of machine the bearing industry wanted.

This survey went far beyond the usual let's-satisfy-the-customer approach. No fewer than eight major bearing manufacturers participated. And more than a year of exhaustive research went into perfecting the design. The result: Industry now has the machine it needs, and Van Norman has the customers it needs.

Three top executives at Van Norman planned the program and coordinated each of its phases: Paul Leming (president), Francis P Healy (vice president and chief engineer), and George P Burns (vice president in charge of sales). Basically, the program consisted of five phases:

PHASE 1: Van Norman experts approached all eight bearing manufacturers to find, as precisely as possible, what type of machine each wanted. In this information-gathering phase, every conceivable aspect of the machine was discussed, and no detail was considered insignificant. What kind of tooling did the industry want? What type of circuitry? How big should the machine be? What type of coolant system should be adopted? How should the enclosure be designed?

PHASE 2: Returning to Springfield, the Van Norman people coordinated all ideas that the industry had contributed. From this mass of data they developed an artist's conception—a full-size drawing.

PHASE 3: Now they went back to the industry with this full-size concept. Each bearing manufacturer examined the concept and offered constructive criticism.

PHASE 4: The refined concept was carried back to the Van Norman plant, and from it a preliminary working layout was developed. Here Van Norman engineers were instructed to follow exactly all suggestions on size, rigidity, and so forth that the manufacturers had made.

PHASE 5: Once it knew what the industry wanted, the company could return with a design that showed what the machine would be able to offer. Furthermore, with its experience in building machine tools, the company improved many of the industry's original suggestions.

Obviously, such careful, intensive research gave the company a better machine than it might have had otherwise. And there are other fruits of collaboration that are just as tasty. The company now has, because of its closer contact with the bearing industry, a much more intimate view of that industry's problems. At the same time the bearing manufacturer has a healthy respect for the machine, because he participated in its design. Finally, several of the outside suggestions and requests prodded Van Norman to include, in its design, means for other miniature grinding operations. As a result, the machine is more versatile. Basically set up to grind inner-race ball grooves, the unit has a modular design that can easily be adapted to other miniature applications.

What the industry wanted

Design of the 1-M Lectro-Cam grinder reflects requests from bearing manufacturers in three areas:

1. Keep it small. A miniature bearing plant, like a medical laboratory, must be spotlessly clean. Construction costs for such plants are high, as much as $25 a square foot. Because of these high space costs, the industry wants its machinery and allied equipment to occupy as small

a space as possible. The Van Norman machine, which weighs 4500 lb, is only 40 in. wide and 40 in. deep.

2. Keep it simple. The bearing industry wanted to eliminate complex systems involving air or hydraulics. It wanted mechanical features that one man, preferably one of its own shop men, could maintain.

3. Keep the tooling simple. In bearing manufacturing, especially in miniature work, setup is complicated and tooling costs are high (as much as $800-1200 for each different part). The Van Norman machine can reduce this cost to $75-100, the company claims. It is also more flexible than many similar machines, because some setups serve a range of parts.

Besides these three general requests, there were more specific individual requests. Some manufacturers, for example, wanted a machine that could handle non-magnetic work. Others asked for a grinder that would place fewer limitations on thin-wall work. Other typical requests: keep the grinding exposed; provide a removable workhead; build fail-safe size compensation into the machine.

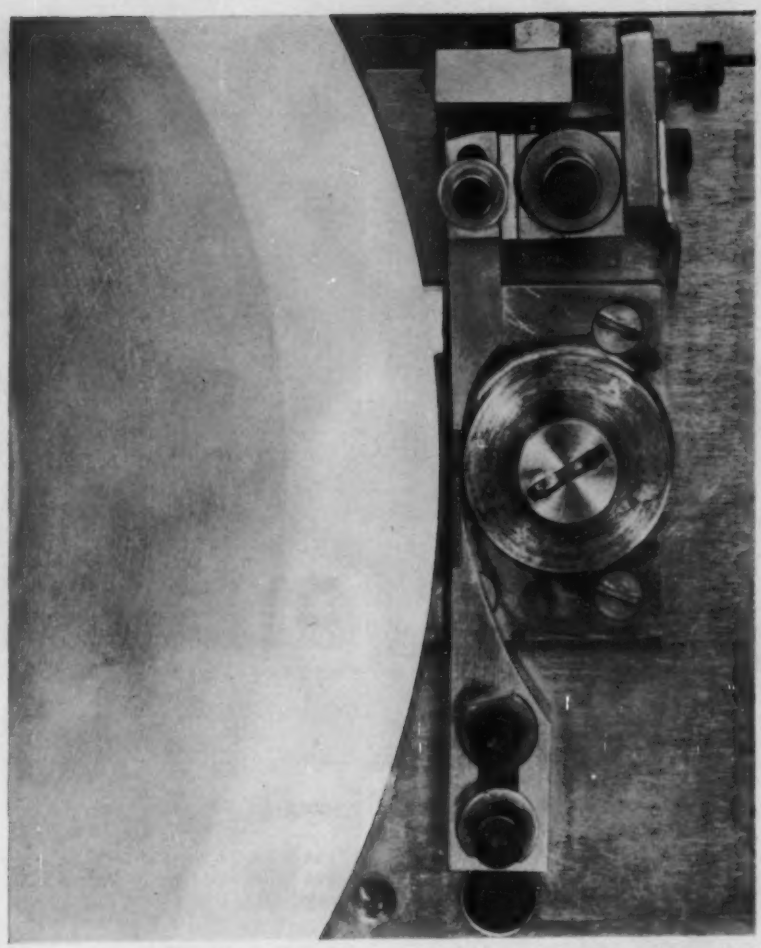
The grinding operation

Like the machine's design, the grinding operation features simplicity. To machine a miniature race, the operator positions it 1/32 in. above the centerline of the grinding wheel, as in a typical centerless-grinding operation. The workpiece, positioned between the grinding wheel and a high-speed-steel control wheel, lies atop a carbide-tipped work-rest blade. A hold-down finger, in vertical alignment with the work-rest blade, presses the work securely against the blade.

Cutting of the part is done with a grinding wheel that has been dressed for the radius required, and thinned for proper contact with the part.

As grinding progresses, pressure is regulated by the Lectro-Cam infeed, in which a master cam controls rapid traverse, fine feed, and grinding-wheel retraction—all automatically. Movement of the cam during the grinding operation energizes electrical circuits that control wheel movement. Incidentally, this master cam can be used on all the jobs that the machine can handle (maximum work size is ½-in. diameter). A mechanical adjustment of the cam is the only change required.

Besides the Lectro-Cam feed control, the machine has another feature of special interest: Van Norman calls it coordinated dressing and size compensation. As the grinding-wheel dresser advances for a dressing cycle, an infeed unit connected to the control wheel receives a signal, which causes the control wheel to advance the same amount to correct for size.



In grinding operation the tiny workpiece is positioned (between grinding wheel and control wheel) atop a work-rest blade. A hold-down finger keeps work securely held against work-rest blade during the grinding operation

Two other features deserve mention here:

- An easy-to-read control panel (see picture) enables supervision to see that the machine is being operated at pre-set rates. All rates are set on knobs visible from the front of the machine, and there are indicating lights for the grinding cycle, grinding-wheel start, regulating-wheel start, and dresser start.
- The filtration system consists of a simple, basket-type receptacle with a replaceable fabric liner. In this system, coolant is delivered under controlled pressure to a hooded enclosure, which confines the mist that forms. Coolant can be water-soluble, an important point in the super-clean miniature bearing plant. A water-based coolant, Van Norman claims, will work just as well on its machine as an oil-based coolant.

Future plans

Its program of integrated industry design has been a striking success, Van Norman states. By its personal contacts in the bearing industry at all levels—management, engineering, and production—the company gained constructive criticism that was of immense help in the design of its new machine.

Indeed, the program has been so successful that Van Norman plans to use the same technique in the design of future machines. The investment in such extensive research can be sizeable, but the payoff in improved relations—and improved machines—justifies it, the company believes.

Mr Meanor's Misdemeanors for the Stout . . .

or

Where to Eat in Chicago 1960 Edition

By Anson E Meanor
AM/MM's consulting gourmet

Three times makes a tradition. And here, by popular demand, is the third edition of Anson Meanor's inimitable tips on that unique collection of restaurants in Chicago. This guide, originated by our then-Chicago representative Anson Meanor for the 1947 Machine Tool Show, has become the most popular and admired, reprinted and quoted key to Chicago dining. Here, revised with loving care by a gourmet who knows and appreciates the best, is our guide to dining after the Show.

American Machinist / *Metalworking Manufacturing*

August 8, 1960, pages 83 to 92

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Like Winston Churchill, I am easily pleased with the best of everything. I certainly enjoy the simple straightforward food of the rich. So I like to share my knowledge with visitors to Chicago.

This list is made especially for those in town for a few days attending the Machine Tool Exposition. All places are very close to the downtown hotels—less than a dollar cab fare—except Ivanhoe.

No pretense is made that this is a complete guide to Chicago eating. All you can be sure of is that you will always get good food at these places. If someone you know recommends some other place, by all means try it.

I have tried to give you a comparison of prices by quoting the cost of a filet mignon, a standard entree almost everywhere, but remember that it is one of the most expensive dishes.

Here are some good suggestions:

Make reservations.

Tip the head waiter instead of getting tipsy at the bar.

When you get your bill, check it! Most waiters and cashiers are basically honest, but in the rush of an evening, mistakes are easily made.

It seems peculiar that almost every restaurant likes to be described as "intimate." I have called only two or three intimate—and with me that means you can scarcely see your companions across the table.

AGOSTINO'S

7 E Delaware Pl, MIchigan 2-8540. Known for its fine Italian food and at reasonable prices, this spot claims to be the Gold Coast's oldest restaurant. 12-oz filet, $5.50; table d'hote, $2.75 to $6.00. Open daily 5 pm to 4 am.

HOTELS AMBASSADOR

N State & Goethe Sts, SUperior 7-7200. The Pump Room, Ambassador East, is quite probably the most famous dining room in Chicago. Named for the Pump Room in Bath, England, famous 18th century watering spa, the Pump Room in Chicago is a colorful counterpart where society and celebrities meet. The piece de resistance is the flaming sword, a diabolic instrument of which some comedian said, "There goes what remains of a customer who left only a two dollar tip." Across the street in the Ambassador West is the Buttery—same food, same good service—and a little less pompous. Here is food as good as any in Chicago and very, very expensive. Filet mignon is $6.75 or $7.00—with nothing else. Bread and butter is extra. Open daily and Sunday from noon. Entertainment tax when dancing begins.

BARNEY'S MARKET CLUB

741 W Randolph St, ANdover 3-9795 & 9800. In the market district, a real man-type restaurant for you. They're really talking to you when they shout "Hiya Senator" when you walk in. It's a trademark. This place doesn't fool around with frills—just good food in large portions. Especially well known for steaks and prime ribs. Their broiled lobster has earned a wide reputation. They don't fuss much with desserts, but you won't want one anyway. Dinners from $2.50, 12-oz filet $4.60.

BELLINI'S

1014 Rush St, WHitehall 4-6576. Not a restaurant at all. How do you like your coffee? Why not have your after-dinner cafe espresso in the pleasant atmosphere of Chicago's finest coffee house. No liquor is served. That means you cannot have coffee with brandy. The coffee—Italian, Caribbean, Espresso, Royal, Brazilian, Turkish, Capuccino, Tonico, Au Lait—or anything else you can name is perfectly blended at Bellini's. Also teas and cocoa. Be sure to have one of their delicious pastries. They are open from 4:30 pm to 1 am, Tuesday through Friday; 1 pm to 1 am, Saturday and Sunday. Closed Mondays.

THE BERGHOFF RESTAURANT

17 W Adams St, HArrison 7-3170. The Berghoff has been a favorite eating place for Chicagoans and out-of-town visitors since 1898. In the past sixty years it has grown in size and reputation but has retained much of its original atmosphere. It is nationally famous for its German specialties, but the menu also has a large variety of sea foods and American dishes including prime steaks as well as game in season. Prices are popular. Open daily except Sunday from 11 am to 9:30 pm.

BINYON'S

327 S Plymouth Ct, WEbster 9-8498. The Binyon family has been in the business over 100 years and is now raising its fifth generation of restauranteurs. Binyon's prime filet or sirloin at $4.75, a la carte. Imported Dover sole. Game dishes. For dessert, apple strudel or old fashioned rice pudding with raisins. Not expensive and emphatically recommended. Both a la carte and table d'hote.

BISMARCK HOTEL

171 W Randolph St, CEntral 6-0123. Many Chicagoans delight in eating in the Swiss Chalet, a dining room with interesting Swiss decor that is unique in these parts. Very high type Germanic cooking. Some of the items on the menu may be hard to pronounce, but they'll be smooth on the palate. Two of the house specialties are Wiener Backhuhn (fried and baked chicken) and Schnitzel Emmenthal (breaded veal steak with melted Swiss cheese). I can never pass up the Swiss Napoleon cake for dessert, so I am not able to recommend anything else, but friends say try the Edelweiss torte. Filets start at $5.00. No table d'hote.

A BIT OF SWEDEN

1015 N Rush St, DElaware 7-1492. A quiet, small favorite place of connoisseurs of Swedish cooking. Founder of this place introduced smorgasbord to Chicago, and it continues to be the specialty of the house, although delicious full dinners are also on the menu. Dinner only. Moderate price. No table d'hote.

BLACKHAWK RESTAURANT

139 N Wabash Ave, RAndolph 6-2822. Specialists with prime ribs of beef. It's actually brought over to your table in a cart with burning coals. Prime steaks broiled on the open hearth. Filet mignon with mushrooms $4.95. You can have your portion carved to your liking. The spinning salad bowl with 21 different ingredients is something you won't forget. The Indian Room serves Chuck Wagon Dinner $2.95. A new idea: Do-It-Yourself Sundae, 65c.

CAFE BOHEMIA

138 S Clinton St, ANdover 3-8310. Rare game dishes are the particular pride of the Cafe Bohemia. Northern moose, elk, venison, western buffalo, bear steaks and chops, all with wild rice, are truly succulent. Give them three-hour notice if you want pheasant or mallard duck under glass. Charming old world atmosphere along with the good eating. Filet at $5.50; 8-course dinner, table d'hote. Open daily 11:30 am to 11:30 pm, except Sundays and Holidays.

BOVERI ITALIAN RESTAURANT

20 E Lake St, ANdover 3-8155. I consider this one of the better places for Italian food. If they have lasagne when you are there, eat it. Prices are very reasonable, Table d'hote $2.20 to $4.25, 8-oz filet mignon, $4.25. Hours are 11 am to 9 pm except Sunday.

CAFE DE PARIS

1260 N Dearborn St, WHitehall 4-5620. When your party includes the ladies consider the Cafe de Paris. This is upper-class dining. Sophisticated. One of Chicago's top French restaurants. Duckling a la Belasco and crepes suzette are nationally famous specialties. A 10-oz filet mignon, $5.25. Open daily 5 pm, Sunday 4 pm.

CHEZ PAREE

610 N Fairbanks Ct, DElaware 7-3434. This is where you go when you want top entertainment with your meal, or without a meal if you prefer. For more than 25 years the Chez has presented Chicago's best night club performances along with good meals. And the Chez Paree Adorables are adorable. Certainly not attractive outdoors—but indoors you feel as if you're in Paris. High priced, but good. 8-oz filet, $5.00.

CHEZ PAUL

180 E Delaware St, DElaware 7-9713. Quiet, very pleasant and authentically French in feeling. Service is particularly good, and a note of graciousness all around. And the food is wonderful. Entrees from $3.25. One specialty—Roast duck, wild rice, orange sauce. 11-oz filet, $5.50. No table d'hote. Papa Paul and son Bill are your hosts.

CITRO'S

181 E Lake Shore Drive, MIchigan 2-3110. The only Russian restaurant I know of in town, it is an outstanding place, specializing in French, Italian and American dishes as well. This aristocratic place on Chicago's Gold Coast was formerly the Yar. My favorite dish is Breast of Chicken a la Kiev, and others have exclaimed over the Beef Tenderloin a la Stroganoff. 7-oz filet, $5.50. Table d'hote $2.50 to $7.50.

CONRAD HILTON HOTEL

720 S Michigan Ave, WAbash 2-4400. Boulevard Room, a theatre restaurant, now this is unique! True entertainment is on ice — really! They roll back the dance floor and presto, an ice rink, upon which skate some of the prettiest little dolls you ever saw. How they manage to think up new ideas and costumes so often is beyond me. This will certainly delight the ladies. House specialty is prime beef, which I recommend. Complete dinners start at $3.50, prime rib dinners, $4.75, filet mignon, $5.75 plus $2.00 entertainment tax.

DON THE BEACHCOMBER

101 E Walton St, SUperior 7-8812. Don the Beachcomber is the original, the most popular, and the most widely imitated of all South Sea Island Restaurants in the US specializing in delicious Cantonese food and original rum drinks. Food service is a la carte only and a nice meal costs around $4.50 to $5.00 per person. Open every day 4 pm to 1 am, except Thanksgiving and Christmas. Ask for Pinky. Say I sent you.

DRAKE HOTEL

Lake Shore Drive & Michigan Ave, SUperior 7-2200. The Cape Cod Room is one of the most delightful places I've known for seafood. Really an intimate place, authentically Cape Cod in appearance. Has as complete a menu of domestic and imported fish and seafood as can be found anywhere — from our own Lake Michigan to the seven seas. Do order their famous Bookbinder Red Snapper Soup with Sherry. For heaven's sake, don't ask for a steak! Rather costly. No table d'hote.

AL FARBER'S STEAK ROOM

2300 Lincoln Park West, LAkeview 5-7375. They serve the very finest of meats. Roast prime ribs of beef (the Rib Eye only) and thick, with special baked potato, and salad $4.95. Charcoal broiled prime filet mignon $5.75. Lobster tail appetizers. One of the finest places to eat good meat. Closed Mondays.

FRITZEL'S

State at Lake. Fritzel ads for years have said "Rendezvous of Celebrities." Indicative of the meticulous service is the fact that the restaurant seats 350 while the payroll numbers 235. The cuisine can be recommended without hesitation. The French chef and his staff make of every dish a gourmet creation. The wine selection is exceptional and the finest filet mignon in the country can be had for $5.95. Fritzel's is open every day from 11 am to 1 am—Saturdays until 2 am. Also Sunday Brunch.

GIBBY'S

192 N Clark St, ANdover 3-8181. Over thirty years in this location (second floor, elevator service available). Specializing in fine steaks, chops, prime rib and seafood with a daily diversified menu of at least a dozen entrees. Not expensive . . . all complete dinners ranging from $3.20-$3.90 . . . generous drinks. A la Carte: 12-oz filet, $4.00; the filet of lake perch is a rare treat and is the dish that made Gibby famous. Sammy Williams, a marvelous entertainer, has been at the piano for over 25 years. Open daily.

GOLD LION

Clinton & Jackson, STate 2-6722. The Gold Lion is famous for its Champagne Dinner, a six-course dinner including such entrees as king size cuts of roast beef (prime rib), lobster tail, breast of guinea hen or thick lamb chops. Complimentary service of imported French champagne or sparkling burgundy throughout the meal. The Champagne Dinner is only $4.75. Other complete dinners from $3.10, filet mignon $5.10. Open Sunday-Friday and Holidays 11:30 am to 9:30 pm, Saturday 11:30 am to 10:30 pm.

THE GOLDEN DEER, THE "HOUSE OF KEBABS"

936 N Rush St, WHitehall 3-2330. The tiny dimly-lit really intimate room which can seat thirty people in any evening between 5 pm and 2 am, is housed in Mid-European atmosphere, complete with candlelight and strolling minstrels. Kebabs include shish, beef, chicken, lobster, shrimp, and kebab combinations. These dishes, which include salad, rice pilav and beverage, can be had for $2.95 to $3.95. The owner is host and bartender and mixes all drinks—he is proud of his martinis —and very rightly so.

GOLDEN OX

1578 Clybourn Ave, MOhawk 4-0780. One of my very favorites when an evening of fun is in order. Good old German cooking, a stein of

beer, gay music, and you're in for a good time. When your thoughts turn to boiled beef and horseradish sauce, or pork shanks and sauerkraut, or plum strudel as only the Germans can make it, you'll be glad you remembered the Golden Ox. It's a small taxi ride out of the Loop, well worth it. 12-oz filet only $5.35. No table d'hote. Closes 2 am.

HARLEQUIN ROOM, FRED HARVEY RESTAURANT

Palmolive Building, 919 North Michigan Ave, DElaware 7-0606. Several Fred Harvey's in the Palmolive, best of which I think is the Harlequin Room. It is distinctive, both in its decor and its food. A specialty is the Rocky Mountain Brook Trout. Saute Meuniere Amandine—best I've ever eaten this side of the Rockies. Not expensive. Filet at $3.25. No table d'hote. Closes 10 pm.

OLD HEIDELBERG

14 W Randolph St, FRanklin 2-1892. Old Heidelberg bears the tradition and atmosphere of its namesake in Germany. I'm sure you will find the dining room serene and charming, but for the little more spirited diner, the Rathskeller with its continental atmosphere and entertainment, Tuesday through Saturday, proves to be quite lively and fun. However, in both you will still enjoy their prime aged steaks, chops and seafood right from the seashore. They are not highly priced and are open seven days a week until 1 am. A 12-oz filet, $5.00, no table d'hote.

HENRICI'S

71 W Randolph St, DEarborn 2-1800. Chicago's first restaurant—established 1868. Traditional dishes now famous: prime beef tenderloin tips a la Deutsch, German pancakes, broiled whitefish. A rosette of whipped cream for your coffee! Not expensive. Filet at $4.85. Closes 1 am.

ISBELL'S

940 N Rush St, DElaware 7-3500. All the way from hamburger to top-grade beef roasts and steaks, served without a lot of fanfare. Several rooms to satisfy your mood—great splendor to casual Western style. Good place to eat if you're cramped for time, for they serve well and far, far into the night. Moderately priced. Filets of every size, charcoal broiled. 10-oz filet, potato, salad, bread and butter, $4.95; 6-oz filet, $3.25. Table d'hote starts at $2.60. Open daily from 11 am to 2 am including Sundays and Holidays.

IVANHOE

3000 N Clark St, GRaceland 2-2771. A "fun place" if there ever was one. A distinctive restaurant, seven bars, of old-world decor—12th century English. King Richard's Armory, Friar Tuck's Wine Cellar, the Black Knight Bar. The only catacombs in Chicago. Besides all this the food is distinctive. And it's hard to say whether it is the food or the atmosphere that keeps you going back to Ivanhoe. Regular menu contains over 25 dinners with new specialties daily. Better than average prices. Dancing included. Filets start at 14-oz, $5.95. No table d'hote. Open daily 11:30 am to 3 am.

JACQUES FRENCH RESTAURANT

900 N Michigan Ave, DElaware 7-9040. True continental decor with beautiful crystal accents and old master paintings for winter and inclement weather dining. The outdoor garden with its bubbling fountain is a treat for summertime lunch or dinner. Filet mignon dinner $5.95. Open daily 11:30 am to midnight.

JULIAN'S (formerly Rickett's)

103 E Chicago Ave, WHitehall 4-9500. Always very crowded. There's seldom room at the bar either. Rugged, Old English style, stained-glass windows, dark hand-hewn beams. Excellent food and drinks, sizable portions to suit any man. Open 11 am to 4 am, the late-hour snacks are delectable. Price moderate. Filet mignon with salad and potatoes, $4.50. Table d'hote from $1.85.

HOTEL KNICKERBOCKER

Walton Pl just East of Michigan, WHitehall 3-2000. Home of the Lime House, authentic reproduction of 18th-century English country pub featuring 16 brands of imported ales, stouts and beers. And now featuring The Great Lakes Room reminiscent of 100 years ago but definitely 20th-century food fare. Dining on excellent filet mignon or sirloin steak priced at $5.00 amid the charming setting of whale oil lamps, murals of 19th-century Chicago and Great Lakes scenes can be a thoroughly enjoyable evening. Open from 7 am to 11 pm, breakfast, luncheon or dinner.

KUNGSHOLM

100 E Ontario St, WHitehall 4-2700. Kungsholm's smorgasbord is most elaborate and a beautiful sight to see. Guests may order smorgasbord as a complete dinner or as a prelude to a variety of entrees such as Swedish baked duck, Kalvfilet a la King Oscar, Danish lobster tail or perhaps the traditional American dishes. Swedish desserts are hard to beat. Rather high-priced. No steak. Table d'hote, luncheon or dinner, $2.25 and up. Open daily from 11:30 am to 10:30 pm; Sunday, 5:30 to 10:30 pm. Famous for the Kungsholm Miniature Grand Opera, for which there is no charge, as guests for luncheon and dinner are invited to attend. More than 1000 puppets, each 13 inches high, perform regularly in the opera classics. This will be of special interest to the wives of conventioneers.

LE PETIT GOURMET

619 N Michigan Ave, DElaware 7-9701. This is a quaint, French-style restaurant, wonderfully pleasant at night—quiet and uncrowded. It's in the middle of the block and doesn't appear to be a restaurant entrance at all. Go through the arch and down the stairs. Summer dining in the outside Italian Court. Also serving brunch and Sunday dinners in the courtyard. Drinks are good, food is pleasantly tasty. Not expensive. Good place for lunch too, but it gets crowded at noon so wait until about 1:00. Filet at $5.00; table d'hote, $2.50 to $3.75. Open from 11:30 am to 2:00 am.

LENARD'S RESTAURANT, "LITTLE POLAND"

1307 N Milwaukee Ave, HUmboldt 6-5614. A short run from downtown. Famous for Polish cooking. Shashlyk is the specialty — marinated tenderloin pieces, tomatoes and onions on a skewer—brought to your table aflame. Some wonderful sour cream dishes. One good old controversial Polish dish that I favor is Charnina—a dark soup, made with duck, served with prunes and noodles. Ask for it if it's on the menu. Very moderate in price. Filet mignon, $3.75. Closes 1 am.

MASON LAFITE

1255 North State Parkway, WHitehall 4-1445. New, featuring outstanding continental cuisine, fine wines. Beautifully decorated dining room.

Very popular. Specialties—Chicken a la Kiev, Tenderloin Tips in Wine Sauce, Wild Rice. Table d'hote dinners from $3.95, filet mignon dinner $5.90. Open daily except Monday, at 5 pm, Sundays at 4 pm.

MAURICE'S RESTAURANT

173 W Madison St, DEarborn 2-2233. Jewish-American restaurant, with food to please all tastes. Even smorgasbord here! Varied menu makes it a good place for a mixed group of gourmets. Service is quick. Not much atmosphere. Not expensive. 16-oz filet, $4.75. Table d'hote from $3.00. Open 7 am to 10 pm.

PALMER HOUSE

State & Monroe Sts, RAndolph 6-7500. Empire Room, one of the finest supper clubs in town. Always has excellent entertainment. In the heart of the Loop and most always crowded. One of their famous dinners is Planked Rock Cornish Hen. Expensive. The Traders down one flight at the Palmer House. Exotic new room under the supervision of the original Trader Vic of San Francisco. Features "foods from the islands" in an authentic tropical setting. Endless selection of rum drinks. Very expensive before it's over. For Empire Room, filets start at $6.25. No table d'hote. Traders' kitchen closes 12:30 am; bar 1 am. In the Traders, 14-oz filet is $5.00.

PAPA MILANO

1169 N State St, DElaware 7-8334. Good place if you're looking for a pizza in the late evening. Very small ground floor, store-front place, better looking than most "pizza palaces." Lasagne and other Italian dishes are terrific. Not expensive at all. 16-oz filet, $4.50. No table d'hote. Closes 4 am.

PEARSON HOTEL, ENGLISH ROOM

190 E Pearson St, SUperior 7-8200. Delicious cocktails and food served in the traditional charm of an English countryside inn. Definitely lives up to its name with a setting of rich oak-paneled walls, a great carved fireplace, subdued lighting and gleaming brass seem to transport you right to the British Isles. You will probably enjoy many of the English dishes on the menu such as lamb chops, roast beef and mixed grills but for those who want just the atmosphere, and a good steak, a 16-oz filet, $5.50, is fine dining fare. The Georgian Room is also a favorite.

PETE'S EST! EST!! EST!!!

535 N Wells St, WHitehall 4-1535 & DElaware 7-9707. One of my favorites. A strange name—with a meaning. Est! Est!! Est!!! is a wine with a fame dating back to year 1110 when it was discovered by a Bishop travelling from Paris to Rome. He had a cup-bearer whose job was to discover the best wine for his Master. He travelled a day ahead and whenever he found the right wine he wrote on the door of the hostelry the word "Est!" (it is!) so that the good Bishop had not the bother to choose his wines. When, however, he came to Montefiascone, his joy and enthusiasm found no limit when he discovered a most marvelous wine. He wrote on the door of the hostelry the words "Est! Est!! Est!!!" (it is! it is!! it is!!!). This is the wine served at Pete's—and it is. But they serve the very finest of steaks, prime beef, charcoal broiled, and the largest and best is only $3.50 with cottage fried potatoes and a vegetable. Also delicious Italian dishes. For dessert—bisque tortoni. If you take only one of my recommendations—go to Pete's Est! Est!! Est!!!.

THE PIT

1139 N Dearborn St, WHitehall 4-5430. Here's another good spot for dinner or late evening eating. Can't call 'em snacks, because barbecued ribs are more than that. They're so good, you'll want to make a special effort to get out here some night, whatever time you plan on dining. Very moderate. 14-oz filet, $5.25. Open 5 pm to 1 am.

PIZZERIA DUE

619 N Wabash Ave, WHitehall 4-9200. Pronounce "doo-ah". Means "two", for the second such pizzeria under same management. I like this place better—it's in the English basement of an attractive old three-story mansion. Nicely decorated in European manner, looks Frenchy, but is Italian, of course. Not much variety in food, but just about the best pizza around. A good late-eating place, or are you one of those who can make a meal of pizza? If so, at dinner time then. Considerately priced.

THE RED CARPET

28 W Elm St, MOhawk 4-2788. A charming old Chicago brownstone converted into a chi-chi rendezvous for gourmets—where the owners, Jerry and Diane Kovler, personally roll out the red carpet to insure your enjoyment. The Haitian Bar and Cocktail Lounge are on the first floor. Leisurely Continental dining on the second floor with vintage French wines accompanying such dishes as Escallope de Veal Imbotti, or Lobster Pernod Flambe to tempt you. Intimate, expensive.

RED STAR INN

1528 N Clark St, WHitehall 4-9637. More than a landmark, the Red Star is a tradition. Opened in 1899, its founder's policies are unchanged today. Only a few structural changes have been made in the building over the years. Art glass dealers have frequently made offers for the mural-decorated leaded windows. You would be hard put to find a more varied menu. Where else can you eat Hoppel Poppel, a combination of scrambled egg, frankfurter and mushroom? Or Zwiebelfleish au Gratin? A wonderful specialty is the apple pancake. Not high priced. 14-oz filet, $4.95 with grilled onion, au gratin potatoes, and peas. No table d'hote. Closes 12 pm.

RICCARDO RESTAURANT & GALLERY

437 N Rush St, WHitehall 4-8815. Riccardo was an artist himself and he promoted many a bright talent by hanging young artists' paintings in his restaurant-gallery. Behind the bar are seven large and famous (or infamous?) murals, which are good for much conversation. Riccardo's is an official art gallery and changes exhibits every month. Besides all the art, this is one of the finest Italian restaurants in the business. This is another place where I wouldn't order a steak. Not that it wouldn't be good—but with such a generous selection of marvelous Italian dishes, it hurts me when anything else is ordered. Large variety of wines, and mixed drinks are well done. Prices you can meet. 13-oz filet, $4.25. Lunch 11:30 am to 3:30 pm. Dinner 5 pm to 2 or 3 am. Sundays open at 4:30 pm.

SHERATON TOWERS

505 N Michigan Ave, WHitehall 4-4100. Try the Camelot Room for a pleasant dining treat in Medieval English atmosphere. Ask for "Cindy" when making reservations and mention my name. Filet at $4.90. No table d'hote. The Brass Bull, fine steak house on Michigan Avenue level. Prime steaks, chops, excellent lobster, whitefish et al. Jimmy Cassidy's honky-tonk piano enlivens evening hours and makes for good community singing. Open for lunch from 11:30 am.

STOCKYARDS INN, SIRLOIN ROOM

4178 S Halsted St, YArds 7-5580. The manager says, in the understatement of the year, "During a show at the Amphitheatre the facilities of the Inn are somewhat strained." At the steak throne you choose and brand your own steak and the chef cooks to your taste. Served with french fried onions, potatoes, salad, rolls and butter—16-oz sirloin, $5.75. Other facilities open to the public during shows are: The Tavern of the Inn, Matador Room. Four Seasons Room. Harvest Room, Sir Thomas Lipton Room, and Little Gallery. In addition to these facilities, and something not generally known to the visiting public, the Saddle and Sirloin Club (second floor of the Inn) is open for luncheon and dinner during shows. The Club has its own menu, with prices slightly higher than the Sirloin Room. The restaurants of the Inn are open daily from 11 am to 2 pm for luncheon; from 4:30 pm 'til closing for dinner. In all cases, during shows, reservations are recommended.

STOUFFER'S

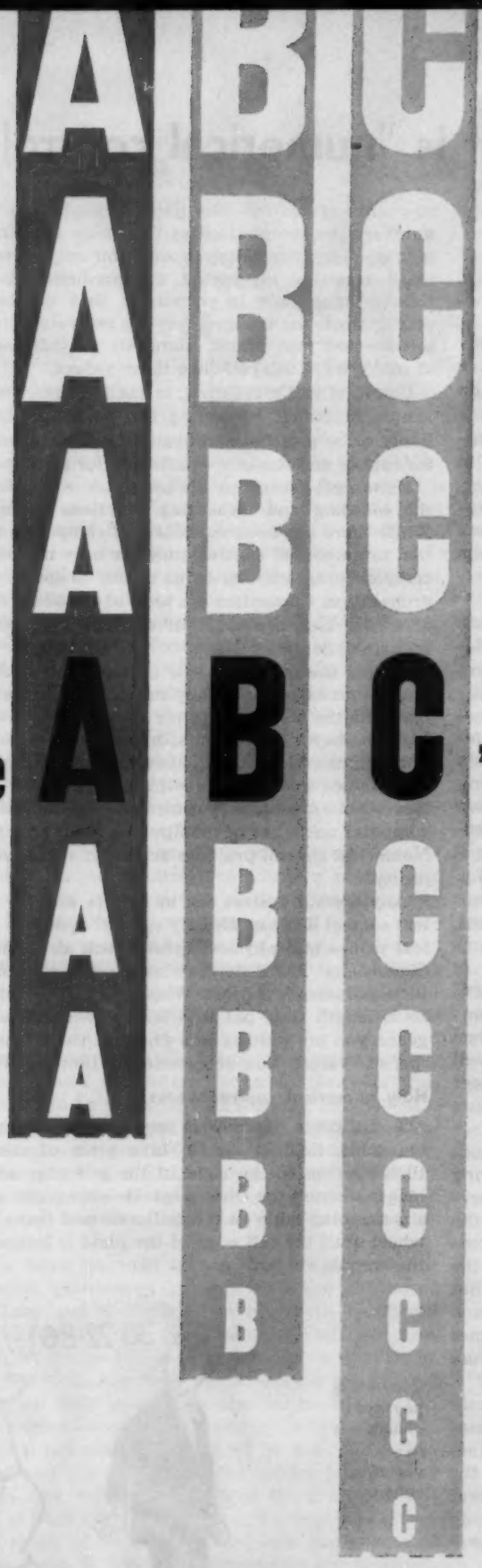
At four locations: Prudential Plaza, MIchigan 2-7676; 32 E Randolph St, STate 2-3711; 24 W Madison St, FRanklin 2-7156; 111 S Wabash Ave, FRanklin 2-1980. Top of the Rock—Stouffer-operated glamor spot atop the 41-story Prudential Building, was completely remodelled, enlarged and redecorated this Fall and became a complete restaurant. Decor is luxurious, lights are low to give drama to the spectacular view. A filet mignon with potatoes, vegetable, salad, coffee—$5.75. Drinks begin at $1.25. Open 11:30 am to midnight. Closed Sundays. The Gibraltar Room, opening off the Prudential lobby, is moderately priced. Open 11:30 am to 2:30 am, except Saturday and Sunday, and 5 to 9, except Sunday. On the ground floor of the Prudential Building, Stouffer's maintains two restaurants. These feature the regular Stouffer menu as seen in the Stouffer restaurants in the Loop. Restaurants are open daily except Sunday from 7:30 am to 9 pm. Complete dinners may be had, including dessert, for slightly above $2.00.

WRIGLEY BUILDING RESTAURANT

410 N Michigan Ave, WHitehall 4-7600. This one gets mentioned "way back here in the W's", but it is nevertheless one of the up-front spots in the city. Reservations sometimes tough, but give it a try. Here's the place whose martinis will fight any other for top honors. And what that chef can do with a lamb chop or pork chop! Each day has its specialties, and "My" salad (that's what they call it) is a real treat.

FINAL ADVICE

Now—if you are completely confused, let's narrow it down to my top personal choices. They are: Pete's Est! Est!! Est!!!; Don the Beachcomber; Wrigley Building Restaurant; Binyon's; Maison Lafite; The Golden Deer; Drake Hotel Cape Cod Room; The Buttery; Al Farber's; Cafe Bohemia; The Red Star Inn; and The Red Carpet.



The A, B, C's of Numerical Control

By William M Stocker, Jr., senior associate editor

Nearly 100 machine tools at the Exposition in Chicago will be operating under numerical control. Knowing what makes them tick, and why this control concept is called revolutionary, may help you evaluate the usefulness of these systems in your plant. Learning these A, B, C's now will give you more time to study the details of specific systems in Chicago.

American Machinist / Metalworking Manufacturing

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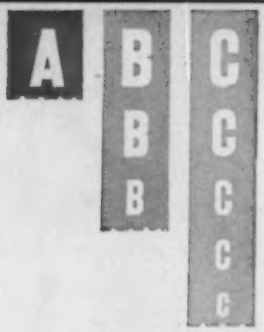


What is "numerical control"?

"Numerical control" is the name given to a fundamental concept of control. This concept is applicable to any kind of process or equipment which must be directed in its operation by human intelligence. Metalworking equipment provides a major field of application for this new control concept. The concept is also used in petroleum processing, food preparation, and to direct chemical installations. Wherever equipment must be instructed to perform its function, there is likely to be a use for numerical control. Every item of equipment now controlled by an operator offers a potential application for numerical control.

"Numerical control" is just what the term implies: **control** by the **numbers.** "Control" and "numbers"—two words—define a revolution in manufacturing.

Control, according to Webster, means to exercise directing, guiding or restraining power over something. To give directions or guidance is to communicate information in the form of advice or commands. These commands can provide instructions. (It's time to get up!); or the instructions can include directions (Go left to the traffic light, then turn right); the command may involve color (Wear a green tie); or it may include a numerical value (Give me six eggs).

Every 24 hours, the average person gives thousands of commands to control more thousands of functions. But, while all of the foregoing examples were commands between people, an even greater number of commands are given by people to inanimate objects. When you open the valve on a faucet you are commanding the water to flow—and to stop flowing when you close the valve. Snapping an electrical wall switch to "On" is really a command to the power supply to provide light. You are constantly controlling things by command.

The big problem is that each of these commands must be interpreted by the person or thing receiving the instructions. And the interpretation, hence performance, of the command can be no better than the accuracy of the command and the ability of the commanded to interpret your information. Thus, if the stem is broken in the faucet the handle will turn but no water will flow. You may ask for six eggs and find only five when you arrive home. How many times have you missed seeing that first traffic light and turned right, and into confusion, at the second one?

In every metalworking shop, millions of commands are given by people to people and by people to machines. Most of these instructions to the machines are given manually. Pressing a button orders the power supply to start the motor. Raising a lever may cause the spindle to rotate clockwise. Turning a handwheel commands a cutting tool to move 0.010 in. into the work.

And that 0.010 in. instruction takes us into a whole new area of control—the finite commands involving **numbers.** As complicated as they may appear, numbers provide information symbols for only three functions—**counting, measuring,** and **predicting.** It is extremely important to remember that numbers are only symbols for values—they are not values in themselves—and that arabic numerals provide only one of many ways to symbolize these values.

Counting and measuring, in normal uses, are fairly simple functions. Predicting can be simple but it is likely to be a more complicated function. It may call for higher mathematics—and even for a computer.

Numerical control in the broad sense requires only the **counting and measuring functions** of numbers. While there has been much talk of computers in relation to numerical control, they are only necessary for complex programming or as means to speed up tape preparation. Computers are tools of the advanced programmer. They are not an inherent part of the simpler numerical control systems.

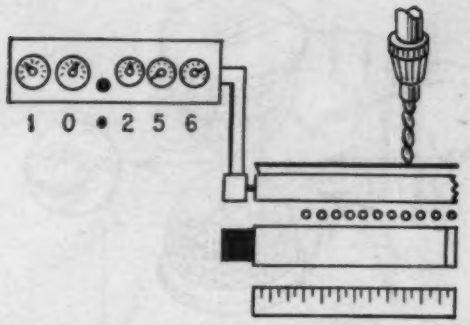
Man is the most versatile control system ever devised—but he is not by any means the most accurate, nor is he the fastest. In terms of modern manufacturing accuracy requirements, human ability to repeat dimensions and to coordinate two or more dimensions (to produce a cam, for example) is extremely limited. Nevertheless, man as a control device complete with computer and a set of manipulators is highly flexible. Numerical control provides accuracy, speed, and flexibility.

Any control system can be said to provide numerical control if it can directly convert symbolic numerical values into physical values, such as quantities or dimensions. The difference may seem confusing but the separation is distinct. When you turn a handwheel, set a length stop, put in a length measure, shift the gears, you are putting in a physical value—not a numerical value. You determine the limits of value.

How numerical control works

A drillpress operator is required, according to the blueprint, to drill a hole in a piece of steel plate 10.625 inches to the right of the left edge and 4.256 inches in from the front edge. He clamps the plate on a positioning table on the drillpress and turns a handwheel until the left edge of the plate is located under the spindle center.

Converting physical dimensions to numerical values



Translate numbers into physical distances

Then he turns the handwheel to move the table to the left 10.625 in. Each full turn of the handwheel is 0.100 inch, hence he turns it 106 full turns and stops at the marking indicating 0.025 inch beyond zero. Next he locates the front edge of the plate and turns another handwheel to move the table out 4.256 inches. And he is ready to drill.

If the handwheels were replaced by gears having 100 teeth each, so that each tooth was equal to 0.001 inch of travel, and a counter was coupled to each gear, the operator would simply zero the counter as each edge was located and then spin the handwheel until the desired dimension appeared on the counter. But the operator still must observe the counter to know when to stop turning. He must slow down or overshoot the final thousandth. He continues to have control responsibility.

Now, let's replace the gears with servomotors. A servomotor is an electric motor which rotates and aligns itself in response to a distinct signal or command. The servomotors we have selected have a value of 0.100 inch per revolution. We attach a common doorbell pushbutton to the servomotor and one push of the button—a discrete signal—turns the motor 1/100 revolution to produce a table movement of 0.001 inch.

To move the table 0.010 inch, the operator now need only push the button 10 times. However, this system would be less practical than the handwheel if the operator had to push the button 10,625 times for one setting and then 4256 times for the other dimension. The point in this theoretical system is that we **now have a control device which can accept numerical values and translate them into physical measurements.**

For a more practical system, we will replace this theoretical pushbutton system with five calibrated dials. Each dial is divided into ten parts, numbered from zero to nine. The first dial on the left will provide 90,000 pulses for one full turn—or a total value of 90 inches. To the right of this dial, a second dial will supply 9000 pulses, or nine inches, in one full turn. Then we come to an imaginary decimal point.

Decimal fractions are provided by the first dial to the right of the decimal point having a value of 0.900 in. per full turn, followed by a second dial valued at 0.090 in. per full turn and a final dial giving a total range of 0.009 in. divided into increments of 0.001 in. each. If 0.0001-in. increments are required, a sixth dial can be added.

By setting the left-hand dial to 10 in., the next dial to zero, the dial following the decimal point 0.6, the next dial to the right to 0.02, and the thousandth dial to 0.005 in., the operator releases 10,625 pulses to move the table 10.625 inches.

This is numerical control. By setting dials to the values called out as numerical symbols on the blueprint, the operator has directed the control to translate these symbols into actual motion of the table for a specific distance. A second set of dials is used to position the table, and the work, to the 4.256 in. dimension. Now the hole location has been determined in two dimensions, called **X** and **Y.** A third set of dials could be added to provide the hole depth. This set provides the vertical, or **Z,** dimension.

To fully understand the concept, this point is essential: Any system that accepts a symbolic numerical value as an input and converts it to a physical value, such as a dimension on the work, as an output, is providing numerical control. All other elements of the system, such as whether the numbers are put in by punched tape or by pushbutton or by dial, or whether or not the system includes feedback, are secondary functions, not part of the basic concept.

A system does not have to have punched tape, punched cards, or magnetic tape to provide numerical controls. These devices serve only as information storage media—as external memories to feed data to the control.

On the other hand, all pre-programmed machines are not numerically controlled. Record-playback systems, in which an operator's procedure in making a "first piece" is recorded on magnetic tape and then is played back to the machine to control manufacture of additional pieces, is not numerical control. The reason: The operator has put in physical movements rather than numerical values. He has simply used a tape recorder to memorize his motions.

Similarly, machines which are preprogrammed by setting length measures and limit stops, or are controlled by tape templets are not **numerically** controlled. In these systems, too, the input data is in physical measurements. (Tape templets, such as are used to control large riveters, have holes physically spaced in the tape in relation to the desired hole location in the work.)

In evaluating control systems, it is important to recognize this distinction. Costs, capability, accuracy, flexibility—all are affected by these differences. "Pro-

Pulse counts transmit data

gram control" is a broad field in which numerical control is only one area, albeit basic and extensive. "Program control" describes any control system which permits a sequence of two or more functions to be performed automatically according to preset instructions. Thus, except for simple inputs such as the direct dial positioning described earlier, most numerical-control systems provide program control. However, all program controls are not numerical.

Input signals can be electrical, electronic, hydraulic, mechanical, pneumatic, optical, etc. The concept is not limited to any one form. As long as the signal can be applied as a numerical value and converted to a physical value by the system any energy form may be used.

Techniques of numerical input, other than the pulse system described earlier, are many and varied. In fact, a method based on comparison is much more common than the system used as an example.

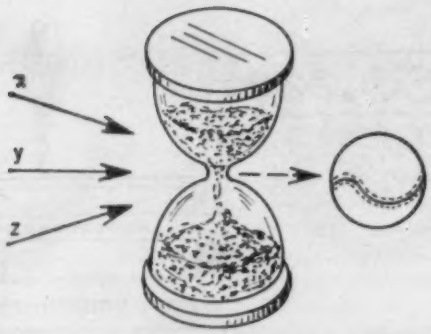
In this method, a signal equal to the desired numerical value is set, by dial or tape, as the input to a comparing device. A second signal is sent to the comparing device by the object, such as a positioning table, being moved. This second signal is equal to the physical distance the table moves. When the physical dimension reached by the table is equal to the numerical value set as an input, the signals are said to "null," or balance, and the table stops.

Positioning vs contouring

In the examples given so far, only the discrete positioning functions of numerical control have been described. Actually, three forms of numerical control exist: simple counting, discrete positioning (also called point-to-point), and continuous-path or contouring. Between the simplest and the most complex systems, many degrees of control are possible. We, for machine-tool control, are concerned primarily with positioning in two or three dimensions and with contouring in two or three dimensions.

Positioning controls are fundamentally point-locating systems. They are used to locate a point, or a series of points, by moving independently in two dimensions (called **X** and **Y**), without regard to the path of their motions, to meet at the desired point. Once that point is reached, a third, vertical, motion (called **Z**) may come into play to provide depth control. Only the end point is important; the tool path is not controlled. Machine tools such as drillpresses, jig borers, turret drills, turret lathes, boring mills, riveters, etc, commonly use positioning systems.

Contouring, or continuous-path, control is an order of complexity higher than positioning. In contouring, the **path** of the tool through the work is important. Thus, the two dimensions (**X** and **Y**), or the three dimensions (**X**, **Y** and **Z**), needed to determine the desired curve or form must be closely coordinated. They must be synchronized by the system after being put into the system as individual dimensions.



TIME is the key to contouring

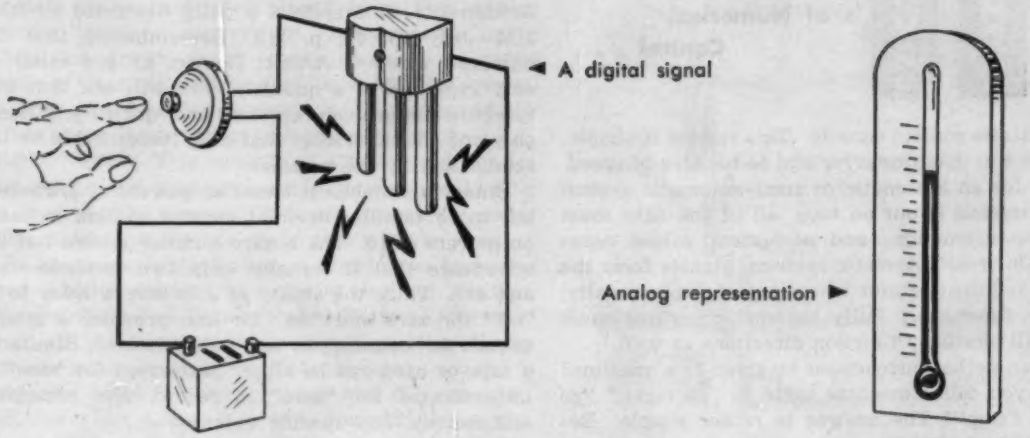
Time is one common denominator which makes this synchronization possible. Theoretically, every line consists of infinite series of points. Thus, the ideal curved line would be generated by an infinite number of discrete positions created by coordinating the two or three dimensions for each position. However, this procedure wouldn't be practical. Instead, the continuous path is generated by a series of minute, overlapping, straight lines or parabolas—none of which is longer than the total dimensional tolerance on both sides of the line. By releasing the proportional signal values for **X** and **Y**, or **X**, **Y** and **Z**, in each of a series of tiny time intervals, each interval produces a short (perhaps only 0.0001 in., or less, long) straight line or parabola. The sum of these lines or parabolas is the desired curve.

Another method of producing contour control is to select one dimension as a standard, or "base," and then proportion the other two dimensions to it.

Computers, as is readily seen, find their greatest value in data processing for contour control. So far, the computer is rarely needed to prepare data for positioning systems. But continuous-path control is a different problem. Theoretically, even the thousands of points needed for contouring can be manually programmed but it just isn't practical. The speed of an electronic computer provides much of the time saving that makes this control method practical.

However, one other value of numerical contouring, with or without a computer, is the original reason for its development. For the first time in human history, it is possible to generate in physical form any true mathematical shape. Demand by the aircraft industry

Original 6-axis control



for a process to mill intricately contoured aircraft and missile wings was the reason the United States Air Force sponsored numerical control research at Parsons Corp and MIT.

More and more frequently you will hear references to a three-, four-, five-, or six-axis control system. "Axis" is another term to describe each of the coordinates within which the control system operates. The primary axes are the three basic dimensions—length, width, and height. Then, around each of these axes is an axis of rotation which provides three more axes, for a total of six. These additional axes are in a sense controlled pivotal points to provide the greater maneuverability sometimes needed to achieve the proper positional relationship between the tool and the work. Numerically controlled inspection machines frequently call for six axes of motion.

Analog vs digital signals

Signals provide the basic means of transmitting information, of communicating between men and men, men and machines, or machines and machines. Regardless of the message sent, the signal must take one of two forms or be a combination of these forms. The two signal forms are "analog" and "digital." Analog signals are continuous, modulated by events to provide the message. Digital signals are incremental, discrete pulses. The signal from your car's speedometer is analog. A telegraph key taps out digital signals, as does a telephone dial.

In the early days of electric power there were spirited, and serious, AC vs DC controversies. Today this issue is dead; engineers use the power form that best accomplishes the job—and they don't hesitate to mix types. So it was with the digital vs analog riffle but, though a few people still argue merits, it can't be called a serious controversy. Most engineers agree that each method has distinct pros and cons.

Digital control systems, also termed logical, are by far the most common, as they are positive and reasonably simple. Commonly, analog feedback data from dimensional sensors, which are "continuously proportional," are converted to digital signals for interpretation and input to the control device.

In general, analog techniques permit low-cost approximate control in simple systems. The cost, as well as the problems of achieving accuracy, multiply rapidly as complexity increases. Digital computer and control systems offer greater possible accuracy at the price of complexity, but a point in increasing demand on the system is reached where the cost of a digital system becomes less than for an analog system to do the same job. Hybrid analog-digital systems have remarkable qualities, not possessed by either system individually, for control systems, computer systems, and computer-control systems.

Analog control is any continuous control in which the control action is directly proportional to the desired machine action. For example, where one turn of a bandsaw control wheel changes saw-blade speed a specific amount or where the position of a servo is **a continuous function** of the input signal, the signal is analog.

Digital control is by steps, or in increments, as is the door chime and all push-button controls. Controllers are said to operate digitally because the relays, contacts, and static-logic and decision elements have specific states only, usually two, such as On-Off. They don't work in between these states in a continuous manner, as do analog controls. Controls that work by pulse counts, such as numerical controls, are another form of digital control.

Leadscrews and hydraulic cylinders, because their function is continuous, are analog devices. Relays and pushbuttons are digital devices because they can be only "On" or "Off." Most numerical-control systems operate as a combination of the two. The numerical input, for instance, is digital and is converted to an analog signal by a digital-to-analog converter for use by the machine-tool components.

Full numerical control calls for three types of information:

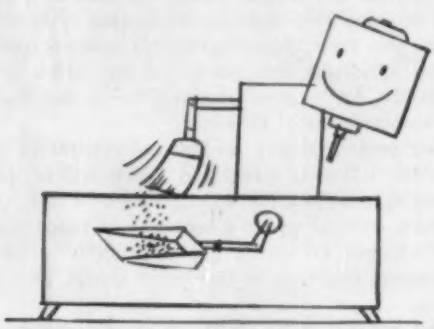
1. Instructions to the machine such as direction of motion, start, stop, reverse, rapid traverse, etc.
2. Numerical values such as dimensions or length of travel and speeds, feeds, number of pieces, etc.
3. Auxiliary functions such as tool changing, coolant on or off, chuck open or closed, end-of-cycle signal, operate lubricator, and so forth.

With a simple positioning system in which an operator dials the numerical, or dimensional, information into the control, he can also provide the instructions and control the auxiliary functions—either by using the controls on the machine or by control

devices on the control console. This system is simple, but subject to operator error and to his idea of speed.

When, for an automatic or semi-automatic system the information is put on tape, all of the data must be there—instructions and numerical values especially. (On semi-automatic systems, signals from the tape can tell the operator when to perform, manually, auxiliary functions.) Fully automatic systems must receive all auxiliary function directions as well.

How can verbal instructions be given to a machine? How do you tell a machine table to "go right," "go left," or "stop"? The answer is rather simple. Because the control system can accept discrete signals, it is possible to instruct the machine by converting the words used in verbal commands into word-signal codes. The same type of word code can be used for



Must be completely self reliant

auxiliary functions. For the instruction, "go right," the coded symbol identifies the command to the machine just as clearly as the word symbol "go right" is understandable to you.

Incidentally, speed and feed changes can be either in the form of numerical information or as auxiliary functions of the control. As numerical data, the exact speed is specified. On the other hand, a series of steps in speed and feed ranges can be coded—and the desired speed or feed step obtained by putting in the code number for the required step. The latter method permits simpler control equipment.

How machines read numbers

When numerical control input is by dial or push-button, in other words manual input, feeding the numbers into an analog system is simple. Arabic numerals, in the decimal system, on the dials can be read directly and a proportional signal fed to the system as voltage, a modulated wave form, etc.

However, the true numerical input form is digital. And digital input calls for discrete values. Whether the input is manual or from tape or cards, the numbers must be supplied to the control in a form it can understand. And a machine can't understand Arabic numerals or Roman numerals. The one form of numerical notation most readily understood by a machine, or a computer, is called Binary Number Arithmetic. This system is fully described in AM/MM—July 25 '60, p. 112. Remembering that the numeral, whether Arabic, Roman, or any other, is only symbolic of a quantity, you will see that any symbolic pattern can represent that quantity. It needs only one characteristic: that it be recognizable by the sender and by the receiver.

Binary arithmetic is based on powers of 2 whereas our more familiar decimal number system is based on powers of 10. The binary number system has the advantage that it contains only two symbols—zero and one. Thus, the ability of a switch or relay to be "off" for zero and "on" for one provides a simple system for counting to any value desired. Similarly, a tape or card can be either perforated for "one" or unperforated for "zero" to record, and remember and convey, any specific value.

In the decimal system, moving a digit (or a numeral) from one column to the next multiplies it by 10 or by one-tenth. Thus the figure 6 moved to the left becomes 60 and moved to the right becomes 0.6. Because changing columns makes a difference of 10 times in a number, it is necessary to have 10 different symbols, or characters, to express all of the quantities in a single column. To recognize a given value requires recognition of all ten symbols plus the position of the symbol. Zeros are simply markers to establish this position. This is fine for humans, but machines prefer a simpler system that is just as good.

Binary number values can be described with only a one and a zero because moving a digit one place only multiplies or divides it by two. A character in the right-hand position is either zero or one; in the second place to the left it is zero or two; in the third place zero or four; then zero or eight—and so on. Any number whatever can be written in a single row using only zeros and ones. Adding the values for each position of a "one" gives the total number. To people familiar with binary numbers, simply looking at the pattern of ones and zeros tells them the total quantity, just as a pattern of decimal digits is immediately recognized for its total quantity. Here are some examples of binary numbers:

Digit value—64	32	16	8	4	2	1		Number
						1	=	1
					1	0	=	2
				1	0	0	=	4
				1	0	1	=	5
			1	1	0	0	=	12
	1	1	0	1	0	0	=	52
1	1	0	0	1	1	1	=	103

Numbers are simply symbols for an abstract quantity, and may be written in any number of different systems. Here are three different sets of symbols, each representing the same abstract quantity:

XXV	=	25	=	11001
Roman		Decimal		Binary

An operator does not need to learn binary arithmetic to use a binary control system. Tape punches are available in designs which accept numbers in the familiar decimal system at the keyboard and convert

the data into a perforated binary form. For simpler systems, tables of conversions are furnished.

The one drawback of binary numeration is the length of time required to symbolize larger numbers. To write 10.256 in., for example, would require 10,256 pulses and a line of holes and spaces 14 digits long: 10100000010000. This number of digits would require a lot of tape and, perhaps more important, would slow the tape reading process. It is one reason for using wider tapes than the one-inch-wide teletype tape.

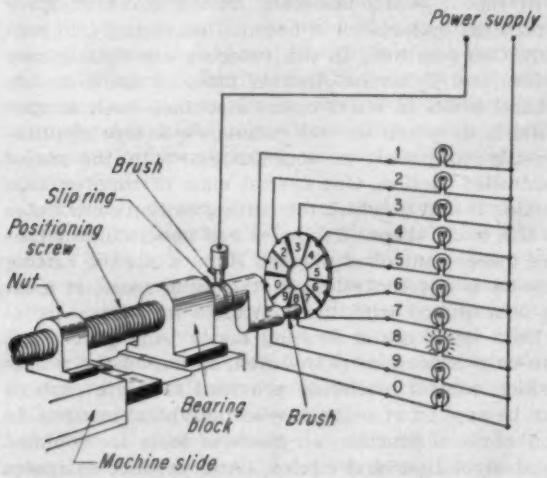
To overcome this problem, a system has been devised which combines binary and decimal position. This system, called Binary Coded Decimal representation (BCD), never requires more than four binary digits in a line because only four digits are needed to show any decimal quantity from one through nine. The binary digits are: 1, 2, 4, 8. These digits, or bits, are usually arranged in a vertical line and then the vertical lines are placed in a horizontal line to match the decimal digit positioning.

Here's an example:

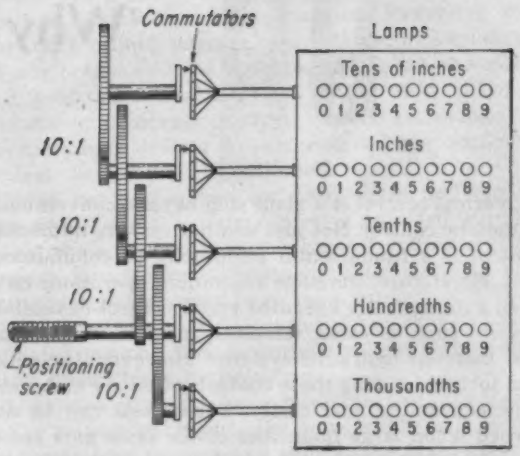
Decimal quantity—10.256		1	0	.	2	5	6
	8	0	0		0	0	0
Binary-Coded Deci-	4	0	0		0	1	1
mal—Representation	2	0	0		1	0	1
	1	1	0		0	1	0
		1	0	.	2	5	6

Binary numbers in this form greatly extend and simplify the use of this kind of arithmetic. For one thing, the symbol pattern can be punched into tape by a conventional tape-punching typewriter, such as the Flexowriter, by pressing the keys for the specified decimal dimensions. Also, it is easier to visually read the numbers from the hole pattern in the tape.

You might immediately notice that the straight binary representation of 10.256 has 14 digits while the coded form has 20 digits—in fact, 21 because there is a separate code pattern for the decimal point —and wonder why it is better. First, the tape punch and the tape reader can more readily and more rapidly handle five short, standard-length lines of digits,



Commutator digitizer is a simple device to translate physical position into a numerical value



Gearing commutator digitizers provides measure to any desired fineness — an analog-to-digital converter

or "words," than one long line. Second, any number from 0.001 to 99.999 can be described in that block of 20 digits. And, the tape reader can, if desired, separately read each decimal digit or read the integer separately from the decimal fraction. The latter might be useful in coarse and fine positioning.

Because a machine can read the simple binary hole-or-no-hole symbols, other combinations of these symbols can provide the code for machine instructions, or for tape reader instruction and auxiliary functions. A standard one-inch-wide, eight-channel (eight-hole) tape offers a maximum variety of 128 discrete symbols in each line of eight holes. Figuring the number of possible combinations is smple. It is *two* (hole or no-hole) raised to the exponent equal to the number of hole positions—2^n, or $2^8 = 128$. Thus, many different functions can be coded into the machine control. Commonly, the first four of the eight holes are used for binary-coded decimal numbers and the other channels provide additional coded information.

Feedback

The engineer's equivalent of a *trip report* is called feedback. Feedback devices in control systems return signals to the director to indicate that the given instruction and numerical value have been achieved—or, if the function is incorrect, how much error exists. In practice, feedback is used in three principal forms: Either the feedback signals simply show you how accurately your command has been carried out, or they feed into the director to provide automatic compensation for error. The third type of feedback is essential to its positioning system in that it continually reports the position of a motion and when this position signal is in balance, or "null," with the input numerical signal, the motion stops.

Systems using feedback for self compensation are called "closed loop," without feedback, or with feedback that serves only to indicate response they are termed "open loop." Feedback is needed in direct proportion to the accuracy and repeatability required of the control system and the ability of the system to transmit an undeteriorated message. Generally, feedback is desirable but it is not always essential.

Why Numerical Control?

Numerical control is a giant step beyond conventional automatic control. Not just another system, numerical control is a fundamental philosophy of communication. Heretofore, complete machining operations have been automatically executed under control of built-in devices such as cams, templets, masters, limit stops, and metered hydraulic systems. However, the setup and tooling in using these controls often are elaborate, time consuming, and costly. These costs can be absorbed when large quantities of the same part are to be made, but cannot be justified in short-run production.

For some applications, it has been possible to achieve reasonably simple setup and control equipment, but only by reducing the variety of operations which can be performed on a given machine. Here again, short-run industries are at a disadvantage for they have little use for special-purpose machinery. Even plants equipped for high production are frequently called upon to make small runs of spares and replacements and the cost is tremendous. Metalworking's average order quantity is said to be under 50 pieces.

Short-run production demands call for automatic machinery whose flexibility is not limited by control equipment and for which entire setups may be prearranged in a form that can be slipped into the machine tool in negligible time, with preparation away from the machine if desirable. Numerical control satisfies all of these needs and provides a few bonus advantages. It is entirely practical to set up two distinctly different parts on the machine and work them with alternate cuts.

For many years we have looked upon our American mass-production know-how as something to marvel at and to be proud of. And we can be proud of the way these methods have elevated our national standard of living; have provided more things for more people at lower cost. But, from a business standpoint, mass production is a necessary evil. Why do we make 12,000 of something, put that something in inventory, and then use 1000 a month for a year? We follow this practice over and over again because we can't write off the cost of setup and tooling on less than 12,000 pieces and still keep the cost per piece competitive. Meanwhile we tie up a fortune in inventory, storage space, and risk of obsolescence or damage. Producing more parts than are needed in any immediate period is only sound when it can't be avoided. Heretofore it couldn't be avoided.

Numerical control is the foundation of a manufacturing revolution because, for the first time, it minimizes jigs and fixtures and setup. It does this by substituting a direct measuring system, inherent in the basic machine tool, for the secondary physical measuring systems represented by jigs and fixtures. These tools are, after all, only special memory devices to transfer dimensions for part duplication. The saving in tooling and setup makes numerical control a practical answer for producing only what is needed when it is needed—and avoiding the cost of mass production.

First, machine-tool characteristics

Broadly defined, machine-tools produce a finished part by cutting or forming the work material through relative motion between some form of tool and the workpiece. This relative working motion is always power-driven, though it may be the only power-driven element of the machine. Because the cutting motion is power driven, it is under what might be called simple automatic control. Regardless of the difference in design and application between specific machine tools, a good least common denominator from the control standpoint is the number of controlled motions.

Thus, some seemingly complex machines actually have only one controlled motion. For example, on a turret lathe, automatic lathe, or screw machine, most of the tooling consists of a single tool or gang of tools which are fed against the work in one direction until a stop is reached, whereupon the tool retracts. An entire job is performed by carrying out a whole series of such operations. Sometimes two or more operations occur simultaneously, but in each case, while cutting, each group of tools in a single setup is controlled in one motion alone. Single-motion control is also represented by a gang-drill station in a transfer machine. Here, hole depth is the only process variable subject to control, disregarding the known drill diameter.

Two controlled motions are provided on other machines to develop the shape of the piece. Conventional manually-controlled or tracer-controlled lathes are examples of two-motion control. When a single-point cutting tool is used on a lathe, the work shape is controlled by radial and axial movements of the tool. Conventional planers and shapers also provide two-motion control.

In recent years, machines having three or more controlled motions have become increasingly important. Common tools in this category are milling machines and jigborers. Another class of multi-motion control arises in multi-cutter machines, such as spar millers, in which several cutting heads are simultaneously controlled in coordination with the major controlled motion. One special class of three-motion cutting is that in which the cutting motion contributes to the work shape. Examples are noncircular lathes and tracer-controlled planers. Here, while the cutting motion is not controlled in the same sense, it must be coordinated with the controlled motions.

Data input is the limiting factor. Any part shape can be produced, or reproduced, on any of the multi-motion control machines, provided that the controls can be applied in sequence—as individual motions. In conventional practice, all machine tools are confined to straight lines and circles. (And product designers are somewhat confined by this condition.) Tool or work motion must be either parallel or perpendicular

Mass production is a necessary evil

to the feed ways. Any other direction of movement requires an additional control device such as a taper attachment, a cam, an indexing head, or by coupled gearing. However, even with these devices, variations usually are confined to some constant rate.

When, for mathematical curves and other irregular shapes, two or more variable motions must be coordinated, the problem becomes increasingly difficult with the increase in specified accuracy and, sometimes, impossible. Shapes can only be approximated by rough-machining and hand finishing. This practice is time-consuming and costly; is difficult of duplication and is seldom absolutely accurate.

Machine-tool control vs human limitations

Machine-tool motions may be controlled in a variety of ways. Old-fashioned brute force by the human operator provides the simplest method. This technique is adquate, though not necessarily efficient for many kinds of work on wood lathes, bandsaws, routers, drillpresses, and similar tools. When this direct method becomes unsatisfactory, step two is to provide the operation with some mechanical advantage, usually a set of feedscrews. But control requires force as well as direction. Operators tire.

Add muscle

Horsepower is the next easiest thing to provide automatically. Power feed is achieved by simply gearing the main power source to the feedscrews. Now the operator need supply only intelligence—which feed to use and when it should start and stop. (The same effect is achieved by installing a separate power feed.) At this stage, the inclusion of more than a one-control system is seldom practical because the operator will have difficulty coordinating two or more simultaneous power feeds. Even coordinating two manual feeds is difficult. Thus, when a cut appears to require combined feeds, one of two techniques is commonly used:

1. The two power feeds are geared together. (They also may be electrically or hydraulically synchronized.) This is done in the spiral-milling attachment for a milling machine, in the taper attachment for a lathe, and in the common thread-cutting leadscrew. Each design provides a form of proportional control called linear interpolation. For non-linear (irregular) control in this category, cams, rapid-return linkages, and non-circular gears are used.

2. The coordinate system of the machine tool is altered, so that the desired cut can be performed by a single controlled motion. In other words, by tool and work. Offsetting the tailstock of a lathe to cut tapers changes the lathe from a cylindrical-coordinate machine to a conic-coordinate machine. Swiveling the table on a miller; using a rotary table; or swiveling the compound slide of a lathe, and using the slide feed, produces the same effect. Tilting the table of a bandsaw or drillpress similarly provides a change in the coordinate system so that cuts at any angle to vertical are more readily attained.

These two techniques are used again and again, even when fully automatic control is provided, both to reduce the complexity of the control system and to increase its efficiency. However, both methods are limited, either by dependence upon human skill, cost of design and setup, or by a restricted range of coordinated control. This is especially true when non-linear shapes must be produced.

In automatizing the basic machine tool, the next step is to provide adjustable stops which will cause the power feed to start and stop at the right places. A variety of limit switches and throwout dogs are used to relieve the operator of some of these repetitive tasks. Thus, in addition to feed, size control is automatic. Still, the operator or setup man must position the stops.

After size control, some form of sequencing control is provided hence the machine can be set up to perform a whole series of operations in sequence. However, these are usually one-motion, or at most two-motion, operations. For this change, many stops are provided on each motion, hence the entire operation can become very complex. The final stage of this development is the transfer machine. Various automatic screw machines, lathes, vertical boring mills, grinders, and many other systems employ a similar approach without sacrificing flexibility to the extent represented by the transfer machines, but even setting up these machines for short runs can be costly in time, tooling, and human error.

For some classes of work, however, variables are so numerous that the number of stops required far exceeds the number which a reasonably automatic sequencing control can handle. Hence, a closely-spaced grid of points is provided by installing an indexing head on each feedscrew, but then the human operator again must control the sequence of operations, the path which the tool will follow through the grid. At this point in the development of control, the numerical-control concept opens up an entire new approach to the problems.

However, limit-stop control can be carried one step further before numerical-control methods are essential. It is possible to provide a continuous series of "stops" in the form of a model or templet of the desired work. Thus, the control also becomes simpler. By adding servomechanisms to follow the model, the machine is given the ability to follow not only the positions indicated on the model, but also much of the ability to follow them in proper sequence. The human operator now roughly controls one or two motions and all other related motions follow the model. Nevertheless, human skill is still a limiting factor—both in model making and in control. Also, good metal removal rates are difficult to maintain.

Numerical control makes it possible to provide a system of control for very simple, basic machine-

A B C's of Numerical Control . . .

tools in which one-, two- or any number of multiple-motions is readily coordinated, sequenced, or otherwise manipulated from readily prepared data. Also, the numerical control system introduces a degree of self-inspection not in any mechanical systems.

And now the entire growth cycle of control bears review. For in the numerical-control concept, developed to solve impossible coordination problems, we find a fundamental system of control, even for simple operations. The ability to convert numbers into physical dimensions bypasses all of the earlier methods of machine-tool control to avoid countless hours of setup and toolmaking. These savings, together with increased accuracy and reliability, have a far-reaching effect on the entire manufacturing philosophy.

How machine design affects numerical-control capability

When the operator of a machine tool is replaced by a numerical-control system, the true inherent capability of the machine is quickly revealed. Without that operator to pat and urge and coddle it, many a machine tool finds itself in a very sad state.

This condition is not so much the fault of the machine design as it is that the machine is being asked to perform in a manner far beyond its intended purpose. For maximum capability, the machine and the control system should be designed as an integral unit.

You will hear much discussion, pro and con but mostly con, about the efficiency of retrofitting.

Actually, before you enter too far into the discussion, it is important to know what type of retrofit is being considered.

On the one hand it is possible to retrofit by replacing a manually controlled table on the machine tool with a complete numerically controlled positioning table package. On the other hand, retrofitting can be done by removing the manual controls from a machine and replacing them with servomotors and the other elements of numerical-control systems.

Retrofitting with a complete package, combining control and positioning table, with the table designed for this system is perfectly sound. Few people will argue with its capabilities for conventional work.

*The author gratefully acknowledges the help of John L. Dutcher, senior application engineer, General Electric Co, in preparing this section.

Glossary of Numerical Control Terms

Courtesy Minneapolis-Honeywell Regulator Co.

ADDRESS A label that identifies for the computer a specific location in its memory where certain information is stored. Serves the computer in much the same way that index tabs on your filing sysem serve you.

ANALOG COMPUTER A computer operating on the principle of creating a physical often electrical analogy of the mathematical problem to be solved.

ASSEMBLE To integrate subroutines and routines into a main program.

ATTENUATION Opposite of "gain" (see "gain").

AUTOMATIC PROGRAMMING A term for all techniques which are designed to simplify the writing and execution of programs. Assembly programs which usually translate from the programmer's symbolic language to machine language, assign absolute addresses to instruction and data words, and integrate subroutines into the main routine, are examples of automatic programming aids.

BLACKLASH Total play in the feed system in terms of linear slide motion.

BINARY-CODED-DECIMAL REPRESENTATION (BCD) A system of representing decimal numbers. Each decimal digit is represented by a combination of four binary digits.

BINARY DIGIT (Bit) In the binary numbering system, only two marks (0 and 1) are used. Each of these marks is called a binary digit. Let's take the decimal number 296 and convert it to a binary number. It becomes 100101000, and we say that it is made up of nine binary digits or bits. This will make more sense after you read the definition for Binary Scale (or Numbering System).

BINARY SCALE (or Numbering System) A numbering system having rules much simpler than those of the familiar decimal numbering system. This simplicity makes the binary numbering system ideal for computers which are highly illiterate devices.
Where the decimal numbering system used ten marks (0 through 9) thus having a radix (or base) of 10, the binary system uses only two marks (0 and 1) thus having a radix of 2.

BLOCK A group of words considered as a unit.

CLOSED LOOP A family of automatic control units linked together with a process to form an endless chain. The effects of control action are constantly measured so that if the process goes off the beam, the control units pitch in to bring it back into line.

CODE A system of characters and rules for representing information in a language that can be understood and handled by the control.

COMMAND A group of signals, or pulses initiating one step in the execution of a program.

COMPUTER Any device capable of performing calculations i.e., carrying out transformations of information.

CONTROL MEANS Part of an automatic control device which makes the corrective action.

CONTROL POINT The value you actually get as the result of some control action.

CYCLING A rhythmic change of the factor under control at or near the desired value.

DAMPING A characteristic built into control systems which diminishes the system's natural enthusiasm for making excessive corrections when it detects something gone awry. Not dampening; no water involved.

DEAD TIME Any definite delay between two related actions.

DEVIATION The difference between the actual value of a condition and the one at which it is supposed to be controlled.

DIAGNOSTIC CHECK A specific routine designed to locate a malfunction.

DIGITAL COMPUTER A computer that uses numbers rather than physical quantities in processing data.

The real argument is against retrofitting a control system to a machine tool by replacing or overriding the manual controls with a numerical-control input. From an economic standpoint alone, the desirability of doing this is questionable. A new and somewhat costly control would be added to an older and partially depreciated machine tool—and the combination would perform at something less than optimum. Even applying a control system to a new machine tool that hasn't been designed to accept this kind of control can have its drawbacks. **Thus, it appears wiser to buy a complete "manufacturing system" of machine-tool-plus-control—and get maximum performance while taking full advantage of the depreciation allowance.**

However, the economic considerations are not the most critical. Mechanical response to numerical control, or automatic control, is entirely different from mechanical response to a human operator. An automatic machine must be "tuned" so that all of its elements function in harmony to produce the desired result. An operator provides intelligent compensations, and anticipates malfunctions, that the automatic control cannot supply. An automatically controlled machine must have inherent stability.

Also, production experience so far shows that a numerically controlled machine tool is cutting metal about 80% of each shift while an operator-controlled machine tool cuts metal only 25 to 30% of any eight-hour period. Thus the numerically controlled machine must do, and does, about three times as much work. A machine tool rests when its operator rests, or slows down from fatigue, hence its performance is to some extent modulated by operator stamina—and numerical-control "operators" do very little resting. The machine tool must have built-in stamina.

Frequency response, sensitivity, lost motion, windup, and play are conditions requiring exceptional attention in the numerically controlled machine tool. Special consideration must be given to gear boxes and gears, to leadscrews, to racks and pinions, to ways and lubrication, to tachometers and regulators.

One of the major problems in achieving fast, accurate performance from a numerically controlled machine tool is the somewhat unpredictable stick-slip characteristic of friction. The most important factor is to keep the actual pounds difference between static and sliding friction to a minimum. It is not the ratio between the two that is important, but rather the actual pounds difference in the two frictions.

Minimizing the possible stick-slip action caused by gearing windup to overcome static friction and then

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DISCRETE UNITS Distinct or individual units. For example, automobile crank shafts or bathtubs would be discrete units as contrasted to petroleum or orange juice, which is produced in one continuous flow.

DYNAMIC BEHAVIOR Describes how a control system or an individual unit carries on with respect to time.

ERROR The margin by which an automatic control missed its target value.

EXTERNAL MEMORY A storage unit such as punched or magnetic tape which is external to the computer.

FEEDBACK Part of a closed-loop system which brings back information about the condition under control for comparison to the target value.

FINAL CONTROL ELEMENT Unit of a control system (such as a value) which directly changes the amount of energy to the process.

FLIP-FLOP A device or circuit with two stables states. The circuit remains in either state until the applicaion of a signal causes it to change.

FREQUENCY RESPONSE Frequency at which output ceases to follow input accurately when feedback loop is closed and input (for measuring) is a sine wave or sine function.

GAIN Amount of increase in a signal (or measurement) as it passes through a control system or a specific control element. If a signal gets smaller, it is said to be attenuated. Gain can also mean the sensitivity of a device to changes.

GATE A logic circuit with one output and many inputs, designed so that the output is energized only when certain input conditions are met. They include And Gates and Or Gates.
An "And Gate" is one whose output is energized only when all of the inputs are energized.
An "Or Gate" is one whose output is energized when one or more of the inputs are energized.

HUNTING Even control or measuring instruments sometimes have trouble finding the target. When an instrument wanders around the target without success, engineers appropriately claim it is "hunting".

HYSTERESIS The difference between the response of a unit or system to an increasing signal and the response to a decreasing signal.

INSTRUCTION A word or part of a word which tells the director to perform some operation.

INSTRUCTION CODE An artificial language for expressing or describing the instructions which can be carried out by the computer.

INPUT Transfer of external information into the control system.

INTEGRATOR A device which continuously adds up a quantity being measured over a period of time. Similar in use to your electric meter at home.

INTERNAL ARITHMETIC Any computations performed by the arithmetic unit of a computer, as distinguished from those performed by the peripheral equipment.

INTERNALLY STORED PROGRAM A sequence of instructions (program) stored inside the computer or control system, as opposed to being stored externally on punched paper tape, pin boards, etc.

LOGICAL OPERATIONS Nonarithmetical operations such as selecting, searching, sorting, matching, comparing, etc.

MACHINE LANGUAGE The set of symbols, characters, or signs, and the rules for combining them, which conveys to a computer instructions or information to be processed. This language is unintelligible to people unless the symbols and the rules for their use are understood. Special equipment is usually needed to convert this language from the form in which it is stored in the computer to a form perceptible to human beings.

MAGNETIC TAPE Tape made of metal or plastic coated with a magnetic material which can store information.

MANIPULATED VARIABLE A quantity—or a condition—which is altered by the automatic units to set off a change in the value of the chief condition under regulation.

MATRIX An arrangement of circuit elements such as wires, relays, diodes, etc., which can transform a digital code from one type to another.

MEMORY A general term for the equipment that holds information in machine language in electrical or magnetic form. This equipment also receives information for storage and

unwind as it meets only sliding friction is the problem. The amount of windup is proportional to the pounds difference between the two frictions. While it is desirable to reduce both types of friction, some friction is useful to provide damping. During early development of this equipment, some people reduced friction to such a degree that hunting became intolerable. In recent years, much as been accomplished with lubricants and bearings to overcome friction.

Frequency response

Perhaps the most critical factor in this technology is the frequency response of the combined machine-tool-and-control system. Frequency response is essentially the frequency at which the output ceases to follow the input accurately when the feedback loop is closed. It is measured by applying a sine wave or sine function to the input and recording, or reading on an oscillograph, the deviation, or phase shift, of the output. Basically, frequency response is a measure of the system's ability to quickly change speed or direction. It is even more critical in continuous-path systems than in positioning—and, in any case, should be as high as possible.

Frequency response directly depends upon both the design of the electric or electro-hydraulic equipment and upon the design and construction of the machine tool itself. The factors that determine the level of frequency response obtainable are the characteristics of the power elements: amplidyne, d-c motor, hydraulic valve, and hydraulic motor plus their connected inertial mechanisms.

Sensitivity

At the heart of every numerical-control system is a "position regulator." It consists of the data input such as manual dials or tape to tell the machine what to do, a position error sensing device (a discriminator or comparator circuit), power elements such as a synchro, a pulse generator, or an optical grating.

Position regulators, with very few exceptions, operate with an error which is proportional to the velocity of motion of the machine slide. The *sensitivity* of the system is determined by, and varies inversely as, the amount of this error. Technically it is described in *inches per second per inch of error* but more commonly is spoken of in inches per minute per inch of error. (Inches per second per inch are obtained by multiplying ipm by 16.7)

High sensitivity is more important in a positioning system than it is in contouring. On a one-dimension motion, velocity error shows up directly as an error in the work. So high sensitivity, and low velocity error, are obviously important. When two or three dimensions are simultaneously controlled for contouring (path) control, the velocity errors in each motion tend to cancel out.

GLOSSARY — continued...

gives out the stored information for later use. The word "memory" usually means storage inside the computer, while "storage" refers to magnetic drums, discs, cores, tapes, punched cards, etc., outside of the control system.

MNEMONIC CODE Instructions for a computer written in a form which is easy for the programmer to remember, but which must later be converted into machine language.

NEUTRAL ZONE An automatic control engineer's version of No Man's Land—a range of values in which no control action occurs.

NIXIE LIGHT A glow tube device which converts a combination of electrical impulses into a visual number.

NOISE Similar to radio static. Meaningless stray signals in a control system that do not require correction, but can cause confusion.

OFF-LINE OPERATION The computer operates independently of the time base of the actual inputs; i.e., Considerable time may elapse between an input to the computer and the resulting output. Can also mean operation of peripheral equipment independent of the central processor of a computer system.

ON-LINE OPERATION Operation where input data is fed directly from measuring devices into the computer. Results are obtained in real time, i.e., computations are based on current values of operating data, and answers are obtained in time to permit effective control action.
Can also mean the operation of peripheral equipment in conjunction with the central processor of a computer system.

OPEN LOOP A control system in which there is no self-correcting action for "misses" of the target value, as there is in a closed loop system. Might be likened to a hunter firing a rifle at a deer; the bullet goes where it's aimed, and if it misses the target, no deer!

OPTIMIZATION A method by which a process is continually adjusted to the best obtainable set of operating conditions.

OSCILLOGRAPH RECORDER A device capable of charting high speed variations in measured quantities, such as temperature or pressure, as found in aircraft testing, for example.

OUTPUT Information sent from the director.

OVERSHOOT Occurs when the motion exceeds the target value.

PATCH A section of coding inserted into a routine to correct a mistake or alter the routine.

PHASE SHIFT A time difference between the input and output signal of a control unit or system.

PLAY Looseness between leadscrew and nut, end-looseness of screw, backlash in other gear meshes, and sometimes, cocking of some machine members.

POTENTIOMETER Probably the most versatile of all measuring instruments. It comes in 36 million variations. It can measure anything from bubble gum mix to nuclear energy generation by comparing the difference between known and unknown electrical potentials.

PROGRAM *Noun:* A sequence of steps to be executed by the computer or control to solve a given problem. *Verb:* To prepare a program.

PROGRAMMED CHECK A check consisting of tests inserted into the programmed instructions, and performed by the control equipment.

PROGRAMMER A person who prepares the planned sequence of events the control must follow to solve a problem, but who need not necessarily convert them into detailed instructions (coding).

PROPORTIONAL CONTROL Control action related to the extent a condition being regulated is off-the-beam.

RANDOM ACCESS Equal access time to all memory locations, independent

This is actually a steering rather than a positioning control hence does not produce a velocity error, as such. There are, however, small errors in the contouring system, like drift in amplifiers, and the higher the sensitivity the smaller the resulting error in the work from these causes.

Under static or low-speed conditions, high sensitivity in the positioning system permits a smaller position error to break the machine slide loose and correct the error. This is called the "resolution ability" of the control. Sensitivity should be high enough to guarantee holding the desired tolerance. Unnecessary sensitivity may reduce positioning speed or add to the cost of the system without any real benefit. Increasing the sensitivity beyond the inherent capability of the machine-and-control system will simply cause oscillation or hunting.

Every mechanism is like a tuning fork—it has a natural frequency of vibration called "resonance." In a manually operated machine tool, resonance affects accuracy and surface finish. In a numerically controlled machine tool, resonance affects frequency response and sensitivity—and in turn, accuracy, speed, and surface finish.

Lost motion

Whether it be largely play or largely windup, lost motion is extremely serious in any servo system, regardless of type. It must be minimized. Some of the undesirable results it can produce include:

1. Instability (hunting) when drive is asked to stand still or move at low speed.

2. Transient error in the work when a drive reverses.

3. Direct appearance as an error in the work when position feedback is taken off the leadscrew or some other part of the gearing, rather than from the machine slide.

4. Causing stick-slip movement at low speeds, when combined with the difference between static and sliding friction in the ways. Windup is especially troublesome here.

Windup

To minimize windup each machine member must be as stiff as is practical. Not only the drive members themselves must be stiff, but also the bearings, bearing mountings, and other supporting members. In addition, windup is proportional to friction hence friction must be held to a low level.

Play

Actual free play in the drive is made up of play between the leadscrew and nut (or rack and pinion), end-play of the screw, and backlash in the other gear meshes. Sometimes play is also contributed by some of the machine members being cocked.

Play between the leadscrew and the nut is virtually eliminated by using a ball screw and two ball nuts heavily preloaded. The ball screw is always desirable especially for contouring controls. It is also desirable for numerical positioning controls but at times economics dictate a less expensive regular leadscrew and nut. Under these conditions, the user must be

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of the location of the previous memory reference.

READ To gain information, usually from some form of storage.

READOUT The manner in which a control displays the processed information. May be digital visual display, punched tape, punched cards, automatic typewriter, etc.

REPRODUCIBILITY The exactness with which measurement of a given value can be duplicated.

RESET RATE The number of corrections per minute made by the control system. Usually expressed as "n" number of repeats per minute.

RESONANCE Natural frequency of vibration of a mechanism.

ROUTINE A set of instructions arranged in the correct sequence to direct the control-computer to perform a common operation or series of operations. For example, "get two numbers-add them together-store the answer."

SENSITIVITY Inches per sec per inch of error resulting from velocity error in position regulator. (Also frequently measured in inches per *minute* per inch of error.)

SERIAL OPERATION Type of information transfer within a digital computer whereby all digits of a word are handled sequentially rather than simultaneously.

SERVOMECHANISM A type of closed-loop control system in which mechanical position is the controlled variable.

SIGNAL Information relayed from one point in the control system to another.

STATIC BEHAVIOR Describes how a control system, or an individual unit, carries on under fixed conditions (as contrasted to dynamic behavior which refers to behavior under changing conditions).

STORAGE CAPACITY The amount of data that can be retained in the storage or memory unit of a computer or control often expressed as the number or words that can be retained.

SUB-ROUTINE A section of a computer program which is stored once in the memory and can be used over and over again to accomplish a certain operation; *eg*, "sine", "log", "square root", "cube root", etc.

SYMBOLIC CODE See Mnemonic Code

SYSTEM ENGINEERING A method of engineering approach which takes into consideration all of the elements in the control system, down to the smallest valve, and the process itself. It is believed to have the most promise as an intelligent approach leading toward fuller industrial automation.

TACHOMETER Speed measuring instrument to determine, for example, revolutions per minute (rpm).

TOTAL LOST MOTION Twice the windup plus the backlash.

TRANSDUCER A device which converts one form of energy into another form of energy; for example, one that coverts a 3 to 15 psi pneumatic signal into a 4 to 20 milliamp electric signal, or vice versa. A thermocouple which converts temperatures into millivoltage is another type of transducer.

TRANSISTOR Tiny element in an electronic circuit that does much the same job as a vacuum tube. It's light, practically unbreakable, long-lived, and highly efficient.

VARIABLE A factor or condition which can be measured, altered or controlled, i.e., temperature, pressure, flow, liquid level, humidity, weight, chemical composition, color, etc.

WINDUP—Windup (as the twist in a leadscrew) necessary to overcome FRICTION, in terms of linear slide motion.

WORD A group of characters occupying one storage location. This unit of information is treated and transported by the computer circuits as an entity; it is treated by the control unit as an instruction, and by the arithmetic unit as a quantity.

WRITE To impart or introduce information, usually into some form of storage device.

willing to sacrifice some of the accuracy for price.

Good roller thrust bearings (two mounted back to back) will minimize end-play in the screw.

Some play must be permitted in the other gearing to allow smooth operation. However, play in the gear meshes is less significant than at the leadscrew. Reasonable backlash in the gear train does not contribute a great deal in terms of linear slide motion. This does not mean that one should use sloppy gearing in the gear box, but it does mean that with a given amount of money and effort to spend, first consideration should go to the ballscrew.

You will hear the comment, "We'll build the machine, and if the backlash is too large we'll take it out." You can take up split nuts to some extent, shim racks, and tighten loose thrust bearings. You can't take the windup or compressibility out of a shaft once it has been made too long or too small in diameter. Careful calculation in the design stage followed by good manufacturing and skillful assembly is the only answer. And this is one of the strongest arguments against retrofitting a machine built for manual control.

Control considerations

People have been heard to say, "This control system costs X number of dollars per axis. We can give you two-axis control or, for one-third more, three-axis control." But it rarely works out this way. For positioning systems, two-axis control replaces tooling. It takes the place of jigs and fixtures; simplifies setup. But an operator still must control hole depth, or the third dimension, and must load and unload.

Three-axis control replaces the operator. Because he isn't there, many auxiliary functions must be performed. Typically, an automatic tool changer is needed. Also, work must be loaded, unloaded, or manipulated. Bars must be fed. Coolant must be turned on and off. All of this equipment will run somewhat higher than "one-third more."

Growth of Numerical Control . . .
traced by AM/MM articles, reports, and new-product descriptions

1960

Auerbach Elecronics Corp, Numerical Control System for High-Speed Punch press. Punched paper tape tells system the size of desired piece and the number, type, and location of the holes. Feb. 22, p141

Swift Ohio Corp, Numerically Controlled Positioning Table has 0.0015-in. accuracy and 4000 lbs capacity. Control unit is General Electric Mark II with ¾-hp brake type motors. March 7, p136

G A Gray Co, Building block Numerical Control for Planers and Boring Mills is a modular printed-circuit system developed by G A Gray and Norden Data Systems Div of United Aircraft Corp. March 21, p165

Lahr Machine and Tool Co, Turret Drilling Machine is equipped with a 20x90 in. stationing table and a six-faced turret head that can be manually or power indexed. April 4, p175

Drillmatic Co, Inc, The Electra is an automatic point-to-point and hole-to-hole tape conrolled unit that can be operated semi-automatically or manually. April 18, p147

Natco Automatic Tool Co, Tape Controlled Natco machines starter mountings on 160 variations of flywheel housings in lots of 50 to 500; turns out finished part in 3½ minutes. May 2, p150

Ferranti, Ltd, Dist by Bendix Industrial Controls Section, Bendix to distribute Ferranti Inspection System, system designed for point-to-point inspection and work positioning. May 16, p142

Hillyer Corp, Turret Drilling Machine Drills Holes at the rate of 15 per minute within 0.0001 in. per foot. June 13, p165

Walter P Hill, Inc, Jig Driller Handles Parts 10 ft. Square, properly positioned, a part 33 ft long can be run on one tape. June 13, p163

Pratt & Whitney Co, Inc, Potter & Johnson 3E-15 Automatic Turret Lathe has optional tape control; designed for fast metal removal. June 27, p149

Pratt & Whitney Co, Inc, PW Introduces Borer, Rotary Table; jig borer is tele phone-dial controlled, rotary table may be positioned either by telephone dial or punched tape. June 13, p161

Warner & Swasey Co, W & S Announces Turret Lathes, Chuckers—25-in. swing Servofeed turret lathe with electronic "memory" system—4-A turret lathe, either carriage or saddle numerically-controlled operated — TAC single-spindle chucker with optional tape-control system. June 27, p147

1959

Giddings & Lewis Machine Tool Company, Magnetic Tape-Control Vertical Boring and Turning Mill. Employs the Numeripath control which introduces the Numericord director and magnetic tape recording and control console with tape play-back unit. March 9, '59 p146.

G&L Kaukauna Division, Tape-Control System Automates G&L Vertical Turret Lathe. System used is for company's vertical turret lathes, provides quick set up, faster operation, high cutting speeds and better quality. March 23, '59, p167

Bendix Computer Division, Bendix Aviation Corp, Automatic programming system introduced by Bendix. Model G-15 digital computer is called POGO (program optimizer for G-15 operations). Provides a set of simplified computer instructions, to help the programmer write a POGO program with a minimum of effort. April 20, '59, p172

Pratt & Whitney, World's Largest Jig Borers are positioned by a telephone-dial system after which the machine's electronic system takes over. April 20, '59, p159

Pratt & Whitney, Numeric-Keller Machine performs Tape-Control Milling in 3-D. Continuous automatic milling of regular and irregular shapes in three dimensions. A higher degree of accuracy under direction of tape-recorded numerical control is accomplished. May 18, '59, p166.

Walter P Hill Inc 22183 Telegraph Road, Detroit 19, Michigan—Low cost numerical control machine performs drilling, milling or jigboring. Controlled by General Electric Mark II universal numerical-positioning control, the machine uses punched tape made by typewriting instructions. June 1, '59 p148

Ex-Cell-O Corp, Tape-Controlled Cam-Milling Machine mills three-dimensional contours complete from the solid fuel metering drum cams. Sept. 7, '59, p160

Carlton Machine Tool Company, Planer type drilling machine has extra-large automatic positioning tape. The 72 by 126-in. table with numerical control can be positioned to ±0.002 in. when tape control is used. Positioning is done through position racks and pinions. Sept 21, '59, p165

Cincinnati Milling Machine Co, A 30 x 52-in. vertical Hydrotel for diesinking; a 16 x 30-in. vertical Hydrotel machining 3-D right- and left-hand parts from a single program; a 20 x 48-in. two-axis positioning machine; and a 48 x 168-in. traveling column Hydrotel for contouring aircraft parts. Oct 19 '59, p134.

Hughes Aircraft Co, Industrial Systems Div, New Control for Machine Tool is completely transistorized. A two-axis numerical machine-tool control for discrete positioning in turning, drilling, punching, riveting, or spot-welding operations. Dec 14, '59, p147

Monarch Machine Tool Co, Numerical Control for Series EE Model 1000 Lathe is a modified General Electric Mark II unit. Dec. 14, '59, p156

Barnes Drill Co, Numerically Controlled Four-Axis Drilling Machine Handles Cylinders, Cones, Ogives. Eight-channel Flexowriter tape supplies the information to the positioning controls and the operator. Dec. 28, '59, p102

Bendix Industrial Controls Section, Bendix Aviation Corp, Unit Controls 3 out of 4 Motions. Designed for switchable, simultaneous and continuous control of three out of four motions of rigid, high accuracy, four-axis milling machines. June 15, '59, p160

Fosdick Machine Tool Co, Telephone Type Cross Bar System. Cross bar is a grating of crossed bars actuated by electromagnets. Bars in X-axis feed information into the switch; bars in Y-axis pick it up, hold it, and release it when needed. June 15, '59, p155

Heald Machine Co and Industrial Controls Section, Bendix Aviation Corp, Turning, Boring Machine Holds 0.0001 in. Tolerance. Model 5 Bore-Matic is a numerically controlled, double-spindle turning and boring machine. It will machine inside and outside contours to a repeated tolerance of ±0.0001 in. June 29, '59, p113

Giddings & Lewis Machine Tool Co, Numerical Control Processing Center developed for G&L by Concord Control Inc, converts punched-tape information into magnetic instructions up to 16 times previously possible rate. June 29, '60, p115

Bendix Industrial Control Section, Bendix Aviation Corp, Two-Axis Numerical Control System was designed for machining complex parts on rotary profile milling machines. Nov 2, '59, p140

Carlton Machine Tool Co, Numerical Control Unit for Boring and Drilling Machines Programming can be done by three methods: Tape for automatic three-axis positioning. Keyboard for separate non-tape operations. Push-buttons for traversing to different data points when needed. Nov 2, '59, p142

Cincinnati Lathe and Tool Co, Low-Cost Tape Controlled Lathe and Drill. Lathe has no manual controls. All functions are controlled electronically or hydraulically from a program tape. Drilling machine has an Acromatic control console with tape reader, table unit, and pneumatic pack. Nov 30, '59, p124

Ex-Cell-O Corp, Numerically Controlled Machine Equipped with Turning, Boring and Grinding Heads. Numera-Trol 922 contouring machine can be electronically or manually controlled in increments of 0.000,025 in. Has one unit for turning and boring, and another for grinding. Dec 14, '59, p147

1958

Superior Machine & Engineering Co, 42-in. Electronic Index Table Positions to One Second of Arc. Omnidex index table, electronically controlled by tape or card, can be used with any machine tool of sufficient capacity. Feb 10, '58, p158

Kearney & Trecker Corp, Numerically Controlled Skin Millers Machine Airframe Skins and Structures. GE's magnetic tape control system is used for automatic slab, straddle, face, and angle milling. Feb 10, '58, p152

Fosdick Machine Tool Co, Numerically Controlled Jig Borer Selects Its Own Tools. Machine functions are programmed by IBM cards for 30 or more tools, positioning of holes, spindle speeds and feeds, hole depth and spindle-head height. March 10, '58, p156

Morey Machinery Company, Inc, Morey Offers Numerically Controlled Profile and Contour-Milling Machine. The Morey A-50 profiler, equipped for continuous-path three-dimensional control, uses the General Electric magnetic-tape control system. March 24, '58, p142

Hillyer Instrument Co, Inc, Numerically Controlled Drill is Accurate to 0.001 in. per ft. Apr 21 '58, p182

General Electric Co, Pre-Engineered Numerical Control Package Unit. The Mark II is a compact two-position unit for any machine requiring point-to-point positioning of linear or rotary motion. June 2, '58, p120

The Cleereman Machine Tool Corp, Cleereman Adds Numerical Control To Layout Drilling. June 16, '58, p125

Pratt & Whitney Co, Inc, Jig Borer Locates to 0.0001 in. Handles Workpieces 70 in. High. The 4EA jig borer is reported to have work-size capacity larger than any other in the world. June 16, '58, p127

Seneca Falls Machine Co, Packaged electromechanical pre-selector system. Set dials to "start" position, length of rapid raverse, and end of cut; also speed, feed, and distance. Positioning plus cam-tracing as an auxiliary function. Dec 15 '58, p135; June 16 '58, p136.

New Britain Machine Co, Lucas Machine Div, Lucas Introduces Program-Controlled Boring, Drilling, Milling Machines. With a General Electric program control, the system uses either punched or magnetic tape. June 30, '58 p108

McKay Machine Co, Numerically Controlled Drill Eliminates Templets and Layout Time. The 2DNC McKaymatic is a two-dimensional numerically controlled drilling machine. July 14, '58 p122

Tracer Control Co, Tape Control System Controls Any Conventional Machine Tool. July 28, '58, p102

Ex-Cell-O Corp, Numerically Controlled 3-D Profiles Around Axis of Workpiece. Numeri-Trol machines are reported to be the first to perform numerically controlled three-dimensional milling around work axis. Sept 8, '58, p127

Morton Mfg Co, Large Steam Turbine Sections are machined in vertical boring and turning machine. Electronic numerical control system prepositions tools vertically and radially. Sept 22, '58 p150

Kearney & Trecker Corp, Operator Dials Milling Machine Program Directly From Blueprint. On the Milwaukee-Mil, functions are dialed on the Dial-a-Cycle control panel by phase-switch dials that control each automatically. Oct 6, '58, p129

CDC Control Services, Inc, Automatic Positioning System Automates Short Production Runs. Point-to-point positioning system uses a direct-dialing analog programmer. Oct 20, '58 p206

General Electric Co, GE Develops Line Of Packaged Numerical Control. Six pre-engineered packages are functionally designated Mark I-M, I, II, III, IV, and V according to number of motions they are capable of performing. Oct 20, '58 p210

Giddings & Lewis Machine Tool Co, G&L Numerically Controlled Die Sinker Cuts Lead Time and costs by 50% or more. Under tape control, the DiMil numerically controlled milling machine can generate any defined surface. Nov 3, '58 p129

Wang Laboratories, Inc, Positioning System Adapts to Both New and Old Machines. Nov 3, '58 p130

Giddings & Lewis Machine Co, G&L Horizontals Offer Over 20 Feet of Vertical Headstock Travel. The Model 880-FUAR has been arranged for adaptation of numerical positioning, numerical contouring, and templet-tracer control. Nov 17, '58 p237

Burg Tool Mfg Co, Tape-Controlled Turret Drill Speeds Small-Lot Production. The six-spindle, Model 2BHT, turret drilling machine is controlled by a GE two-motion positioning unit. Dec 1 '58 p144

Kearney & Trecker Corp, Tape Controlled Universal Machine Tool Chooses Its Own Cutting Tools. The Model II machine uses 1-in. wide, 8-channel tape in its GE control system. Dec 15, '58 p129

Micro-Path, Inc, Div of Topp Industries, Inc, Lowcost Tape-Control System Combines Discrete and Continuous-Path Control. Dec 29, '58 p74

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Allison Equipment Co, Feb 25, '57 p190

Pratt & Whitney Co, Inc, March 11, '57 p174

Barnes Drill Co, May 6, '57 p172

Kearney & Trecker Corp, May 6, '57 p175

Daytronic Corp, July 1, '57 p136

Laboratory for Electronics, Inc, July 29, '57 p144

Burg Tool Mfg Co, Inc, Aug 26, '57 p156

Giddings & Lewis Machine Tool Co, Nov 4, '57 p182

Modern Engineering Service Inc, Nov 18, '57 p188

Barnes Drill Co, Dec 16, '57 p165

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Kearney & Trecker Corp, Dec 30, '57 p120

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Giddings & Lewis Machine Tool Co, June 20, '56 p167

Minneapolis-Honeywell Regulator Co, Jan 30, '56 p134

Baldwin Piano Co, Feb 13, '56 p192

Hillyer Corp, March 12, '56 p209

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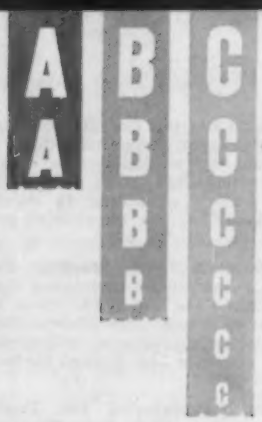
General Riveters Inc, Dec 3, '56 p180

Autonetics Div, North American Aviation, Inc, Dec 17, '56 p164

Warner & Swasey Co, Dec 31, '56 p118

Farrand Controls Inc, Dec 31, '56 p123



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Automatic Contour Control (July 10 '50, p75)

Film Runs Non-Circular Gear Shaper (Feb 2 '53, p149)

Numerical Control, What It Means to Metalworking (Oct 25 '54, p133)*

Turret Punch and Sheet Location Controlled by Punch Cards (Aug 1 '55, p102)

Simultaneous and Sequential Control Tape Gives Turret Lathe Short Run Flexibility (Aug 1 '55, p106)

Preselection and Numerical Control (Engineers Sketchbook of the Shows) (Sept 26 '55, p176)

Three-dimensional Cams by Numerical Control (Nov 7 '55, p172)

Road Maps of Tape Run Big Riveter (Jan 30 '56, p85)

Numerical Control Development Firm Formed in Boston (Sept. 10, 56, p176)

Numerical Control Gains Acceptance Nov 5 '56, p176)

Punched Cards Control Lathe to Teest Ceramic Tools (Dec 3 '56, p128)

Milling Plane Parts With Tape Controls (May 6 '57, p166)

Complete Guide to Numerical Control (July 15 '57,)*

Numerical Control Catches Fire (Oct 7 '57, p154)

Gisholt Unveils "Factrol" Tape Controls (Nov 4 '57, p177)

Production-proved Numerical Control (Nov 4, '57, p145)*

Tracer & Numerical Controls Will Share Limelight in Shop of the Future (Dec 2, 57, p142)

Pratt & Whitney Tape-Controlled Rotary Index Table (pix only) (March 10 '58, p154)

First US Tape-Control Line (March 24 '58, p98)

Programming for Turret Punch Presses (March 24 '58, p116)

Tool Engineers Enthusiastic But Hazy on Numerical Control, ASTE Finds (May 5 '58, p111)

The Line That Made Headlines (May 5 '58, p107)

Tape Controls Cut Drilling Cycles 30-50% (Sept 8 '58, p93)

How to Understand Automatic Control I (Sept. 22 '58, p110)

How to Understand Automatic Control II (Oct 6 '58, p106)

Contour Welding With a Tape-Controlled Tracer (Oct 6 '58, p88)

Numerical Control as Tooling (1/3 page) (ASME topics) (Dec 15 '58, p93)

Tape Plus Target Drills (Dec 29 '58, p49)

How to Get Ready for Numerical Control (Feb 23 '59, p103)

Shall We Buy Numerical Controls (Jan 26 '59, p23)

Numerical Control Chops Spindle-Turning Time (May 4 '59, p102)

Build Up to Numerical Control (April 20 '59, p121)

G & L Introduces Magnetic-Tape-Controlled Vertical Boring And Turning Mill (March 9 '59, p146)

Tape Control Cuts Cam Costs in Half (April 6 '59, p142)

Japanese Numerically Controlled Jig Borer, Milling Machine, Vertical turret lathe (June 1 '59, p107)

Back to "Specials" for Big Jobs (June 29 '59, p87)

Atlas Bulkheads Cost Less With Tape-Controlled Milling (June 29 '59, p94)

Punched Tape Controls Automotive Drill (Aug 10 '59, p96)

Tape Suits Simple Shapes too! (Sept 7 '59, p114)

Tape Positioning Halves Machine Time (Oct 5 '59, p88)

Lower Short-Run Manufacturing Costs (Nov 16 '59, p151)*

Tube Bending by the Numbers (Feb 8 '60, p102)

Self-controlled Lathe Saves Setup Time (Mar 21 '60, p136)

In Japan, too, the Accent is on Numerical Control (May 2 '60, p97)

Standards Speed Electronic Control (May 16 '60, p94)

Boeing Offers N/C Programming Service (May 16 '60, p100)

Plotter-Verifier "Dry Runs" Tapes that Run Machines (May 16 '60, p103)

Automatic Memory Speeds Production Scheduling (May 30, '60, p82)

How Fast do Tape Controls Pay Off? (June 13 '60, p114)

Tape Plus Tooling Make Turret Lathe Practical (July 25 '60, p104)

1+1=10 or Binary Numbers Made Easy (July 25 '60, p112)

*Special Report

Announcing!

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This valuable collection of material (about 175 pages) from the pages of AM/MM—pioneer reporter of numerical control—will be available in late August at $2.50 per copy.

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The reliability of the Avey 250 Turret-Dex matches the quality of the thousands of Avey drilling, tapping, and production machines which preceded it. It is available as either an automatic machine or numerically-controlled with rotary or two-axis positioning table. Pre-selected speeds, feeds, rapid advance, and tapping cycles. Automatic depth control for all spindles.

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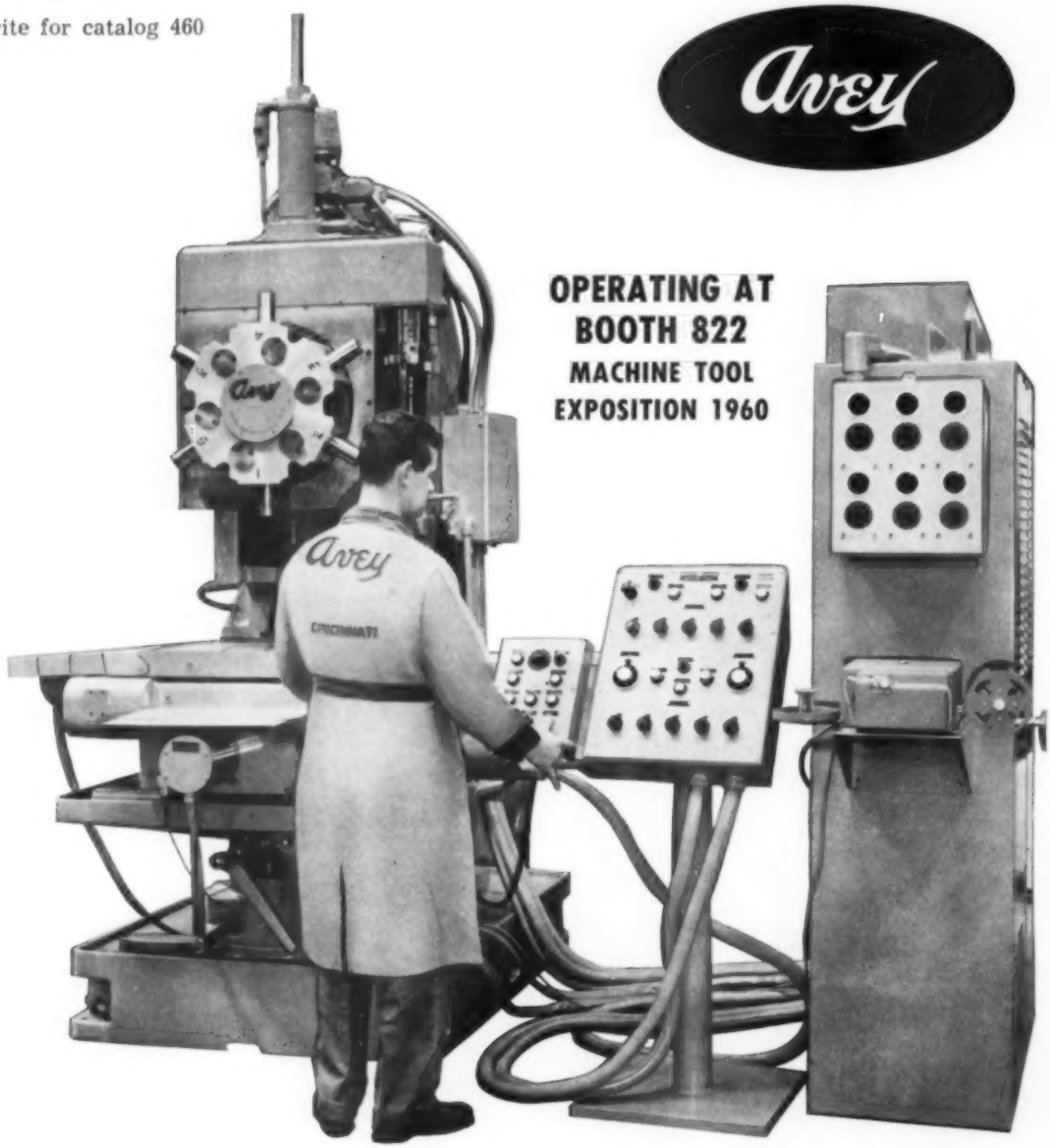
Write for catalog 460

Avey

OPERATING AT BOOTH 822 MACHINE TOOL EXPOSITION 1960



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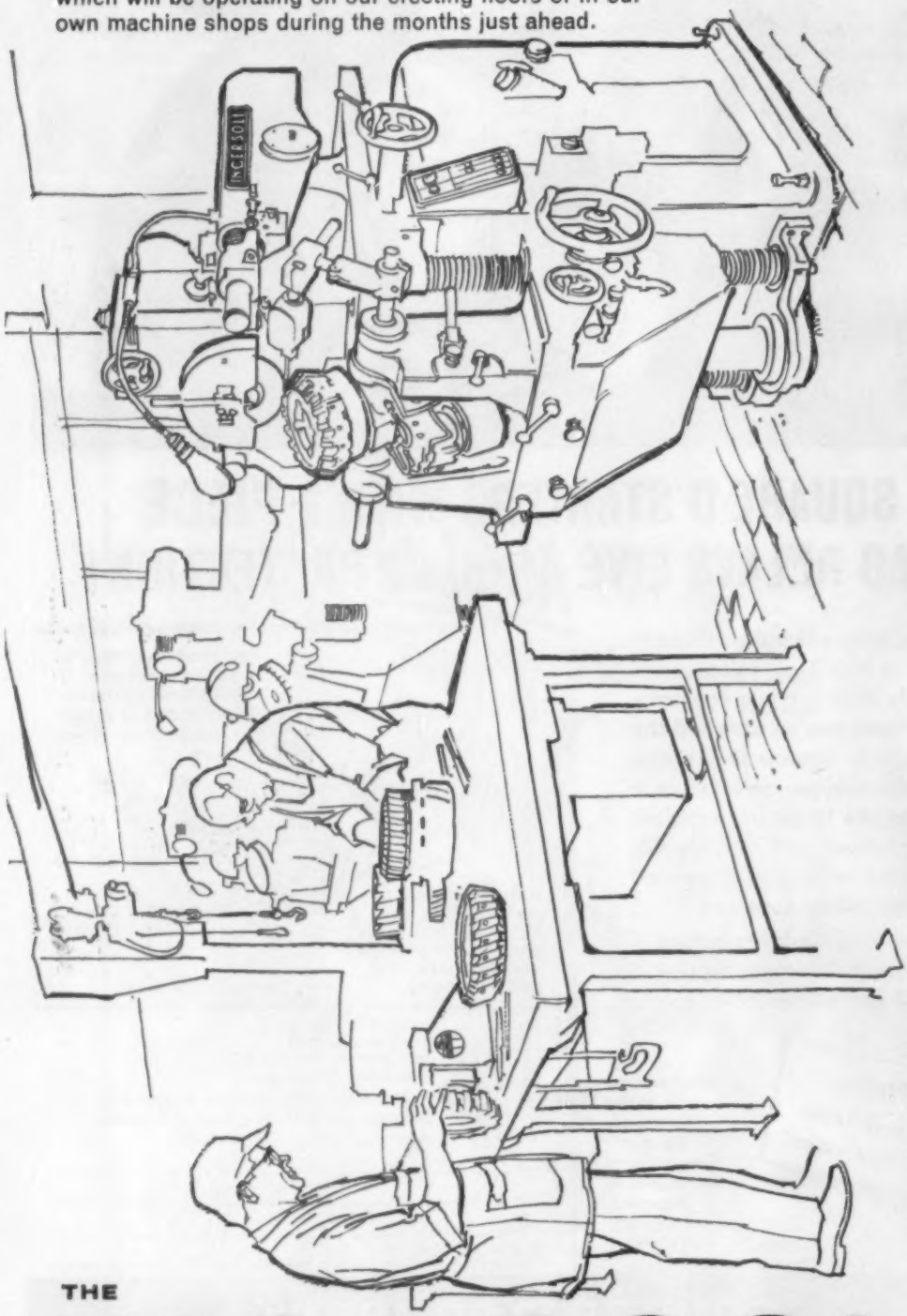
This is one of a number of
NEW INGERSOLL MACHINES
which will be operating on our erecting floors or in our own machine shops during the months just ahead.



A NEW AUTOMATIC CUTTER GRINDER: Cam control of the grinding action makes it possible to control and repeat correct grinds indefinitely, thereby reducing production losses which result when cutters are poorly or inconsistently ground. One man can operate three of these new Ingersoll grinders, which are heavy, precision machines, kept maintenance-free by complete dust protection of moving parts. Using the machine itself to cut its own cams, the operator takes only a short time to produce a cam and completely set up the machine for grinding a new cutter.

THE
INGERSOLL
MILLING MACHINE COMPANY ROCKFORD, ILLINOIS

Runout of Milling Cutters

Source: American Standard ASA B5.3—1960,
published by The American Society of Mechanical Engineers, New York

Type of Cutter	Nominal Cutter Diameter		Radial Runout (when rotated on a stationary shoulder test arbor)		Axial Runout (when rotated on a stationary shoulder test arbor)	
	Over	Thru	Form Relieved	Profile Sharpened	Form Relieved	Profile Sharpened
Arbor Type Cutters:						
Side Milling Cutters						
Shell End Mills		2"	.003	.002	.003	.002
Keyseat Cutters	2"	5	.004	.003	.004	.003
Angular Cutters	5	8-1/2	.005	.004	.005	.004
Gear Cutters						
Convex Cutters						
Concave Cutters						
Corner Rounding Cutters						
Plain Milling Cutters	5"	5"		.003		.002
		8"		.004		.003
Saws		5"		.003		
	5"	12"		.004		
Screw Slotting Cutters	All Sizes			.005		

Axial Runout of Saws and Screw Slotting Cutters

Type of Cutter	Nominal Saw Diameter		Axial Runout (When clamped between Standard Diameter Collars on test arbors) Nominal Face Width					
	Over	Thru	Thru 1/32	Over 1/32 Thru 1/16	Over 1/16 Thru 1/8	Over 1/8 Thru 3/16	Over 3/16 Thru 1/4	Over 1/4 Thru 5/16
Saws and Screw Slotting Cutters		3"	.004	.003	.003	.002		
	3"	4	.005	.005	.004	.003		
	4	6		.007	.006	.005	.004	
	6	8			.008	.006	.005	
	8	12				.007	.006	.005

Radial Runout of End Mill and Shank Type Cutters

Type of Cutter	Flute Length		Radial Runout of Periphery with Respect to Shank (Shank Rotated in Vee Block)
	Over	Thru	
End Mills and Shank Type Cutters		2"	.002
	2"	4"	.003
	4"	6"	.004

Axial Runout of End Mills and Shank Type Cutters

Type of Cutter	Diameter		Axial Runout
	Over	Thru	
End Mills (End Teeth)		1"	.002
	1"	2"	.003
Keyseat Cutters) sides T Slot Cutters)	All		.001

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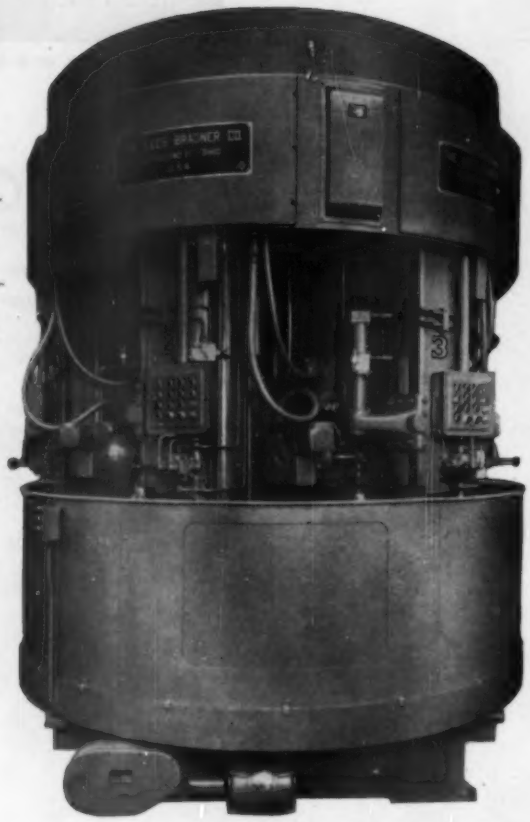

Lees-Bradner Model 7 HD 8″ x 20″ 6-Spindle Rotary Hobber. Also available in single and 4-spindle models.

Here's a complete hobbing production line in one space-saving unit. Actually the Lees-Bradner Model 7 HD 6-Spindle Hobber is six separate and independently operative machines in one. Each hobbing unit incorporates basically the same automatic, high-production features as the remarkable 7 HD Single Spindle Hobber. This includes a heavier, more rugged headstock, heavy-duty column and a 7½ H. P. motor on each spindle. This amazingly efficient machine not only saves valuable floor space but, with its pushbutton controls and automatic features, actually controls the operator thus reducing the chance for human error or slowdown. Chips and coolant are easily carried away from the headstock by the elimination of flat surfaces.

So, if your manufacturing space is valuable and high unit production important, ask your Lees-Bradner representative to give you the story on the ultra-efficient 6-spindle and 4-spindle rotary hobbers. Write or wire us direct for his name and address.

New 7HD HOB HEAD with 3½ inch hob shift. *Just dial it!*

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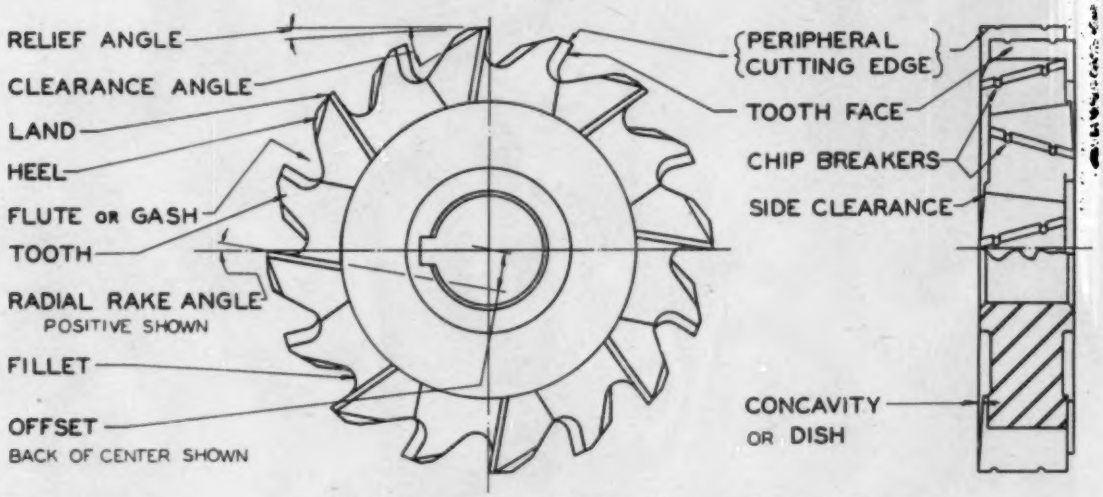
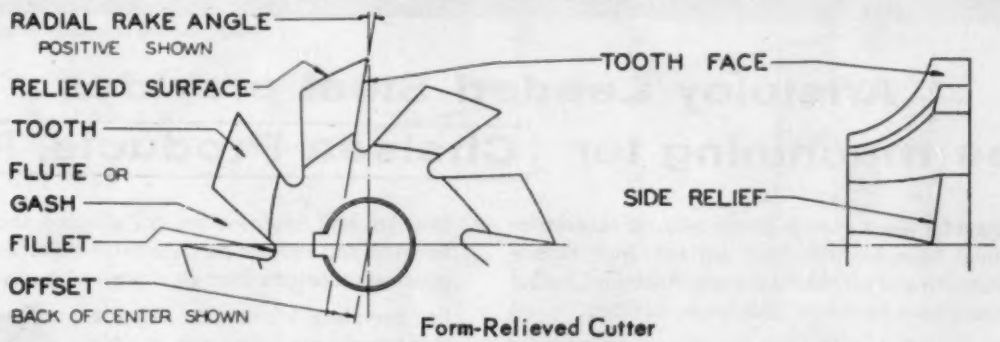
CLEVELAND 11, OHIO, U. S. A.

Milling Cutter Elements

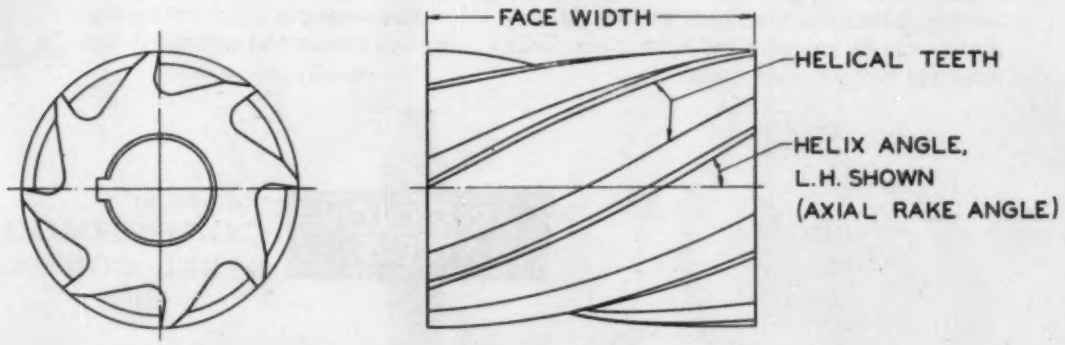
Source: American Standard ASA B5.3—1960,
published by The American Society of Mechanical Engineers, New York



Profile Cutter (Staggered-Tooth Side Mill Shown)



Form-Relieved Cutter



Helical Plain Milling Cutter

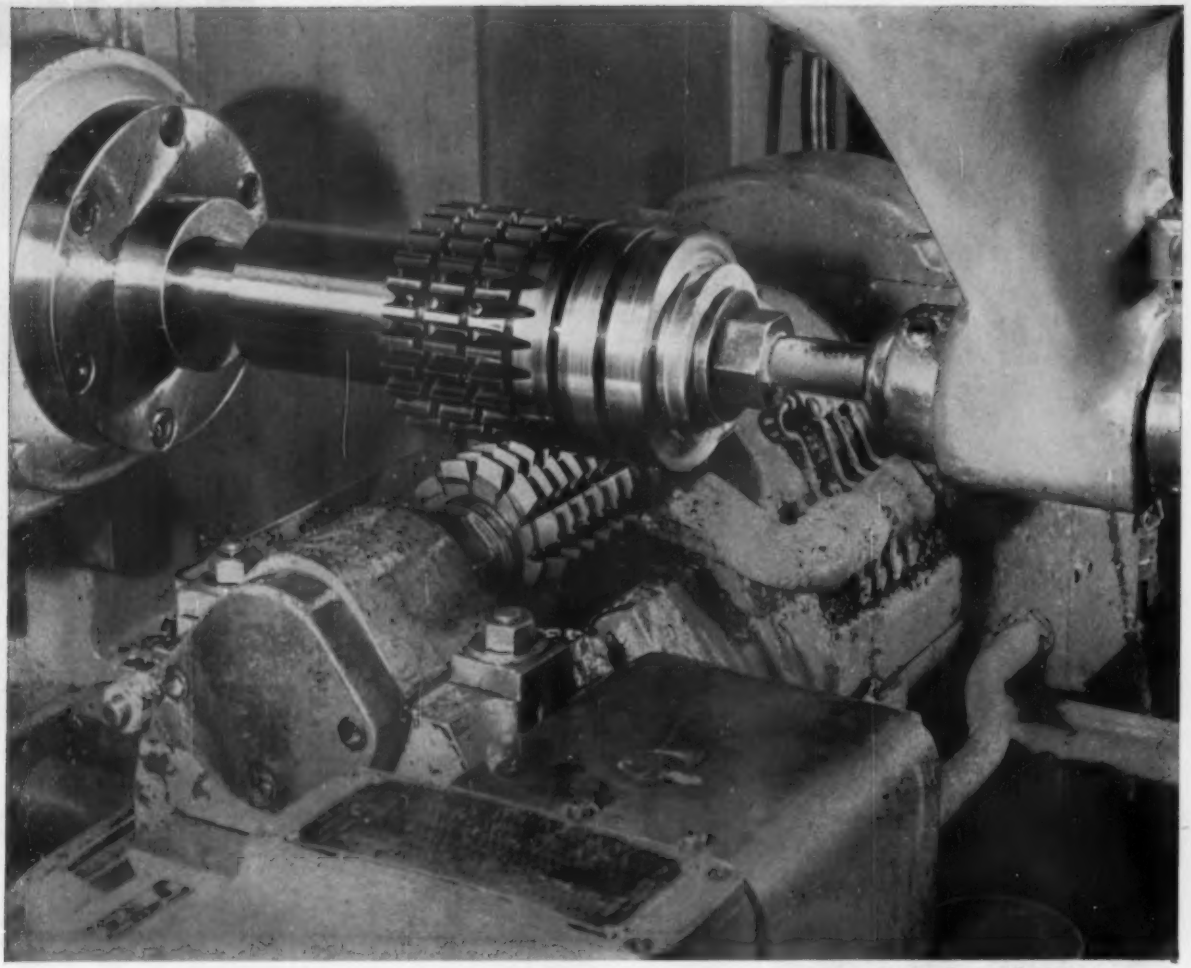


Photo courtesy Chelsea Products, Inc.

Aristoloy Leaded Steel provides free machining for Chelsea Products, Inc.

Steel for gears used in power take-off assemblies must have uniform hard surface, high tensile strength and yet machine freely. Aristoloy Leaded* users have benefited from these qualities.

Chelsea finds more gears can be cut from leaded Aristoloy before the hob needs sharpening. Production can be improved and speeds and feeds increased over non-leaded steel.

Strength and hardness are not affected and the finished part reveals no detectable difference in physical properties from steel previously used.

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Capacity of Tanks

By Ferenc Kuchta, mechanical engineer, J Wiss & Sons Co, Newark, N J

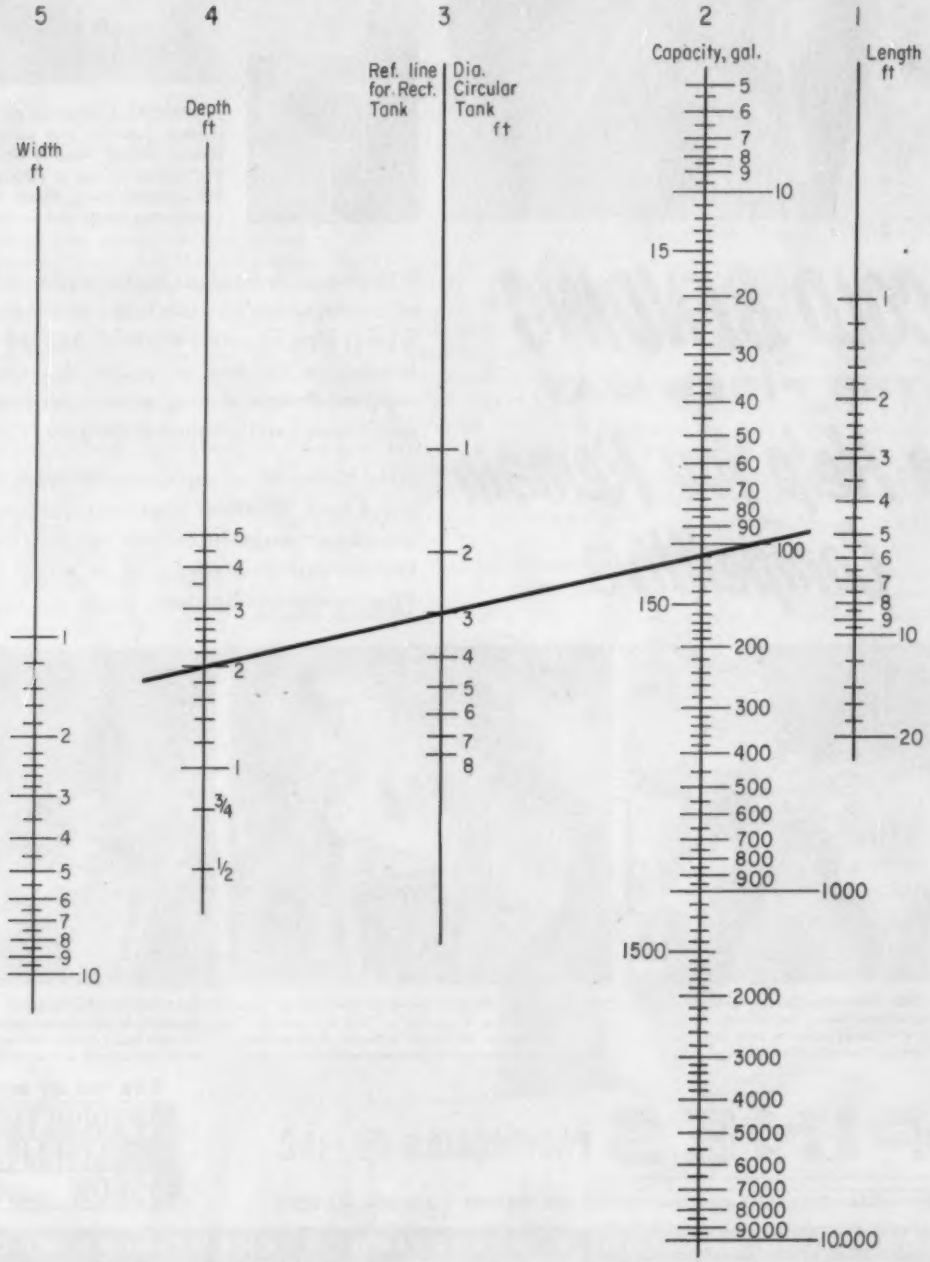
Capacities of round or rectangular tanks in gallons, or dimensions of tanks for a stated capacity can be found with this nomogram.

PROBLEM 1—What is the capacity of a tank 3 ft dia by 2 ft deep?

Solution: Enter nomogram at 3 ft, line 3 and connect with depth—2 ft, line 4. Capacity of the tank, line 2, is read as 106 gal.

PROBLEM 2—We have a space 6 ft wide, 7 ft long and 5 ft deep, into which we can put a rectangular 900-gal. tank for a cooling system. What is the required depth of the tank?

Solution: Enter line 5 for tank width of 6 ft and connect with 7 ft length, line 1. From intersection of dash line with the reference line 3, draw a second dash line to 900 gal., line 2, and extend to line 4, to read depth = 2.85 ft. So, tank dimensions are 7 x 6 x 3 ft.



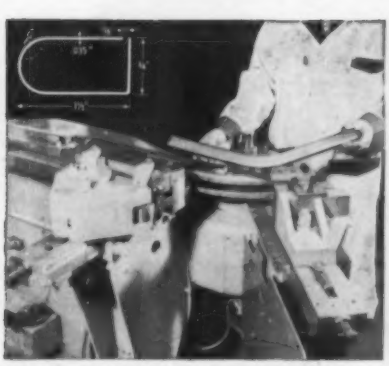
HIGHCHAIR SIDE FRAMES—formed on this PINES Model 3-T Bending Press at speeds up to 1000 bends an hour. Bends are made progressively with angles accurately controlled by the automatic angle-of-bend selector, and plane and location of bend determined by the system of stop gauges.

A DIFFICULT ALUMINUM EXTRUSION BEND—Preventing distortion and warping was difficult in making this 90° bend in 6063-T6 aluminum on a 9¾" inside radius. A split-type bending die and link mandrel, on a Model 2 machine, produced wrinkle-free bends with no distortion.

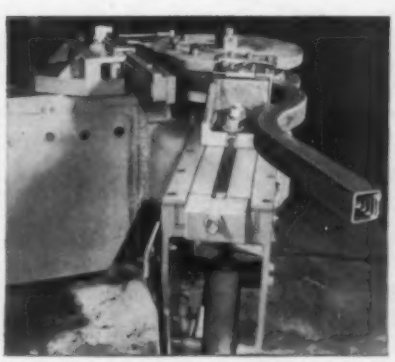
COLD BENDING
THE PINES WAY
Can Help You Remain Competitive

• High-quality bends at high speed is the key to a favorable competitive position in the fabrication of extrusions, tubing, pipe, or rolled sections. And the PINES WAY of bending is the key to quality and speed. It includes superior design, tooling to suit the job, provisions for quick setup, and competent service.

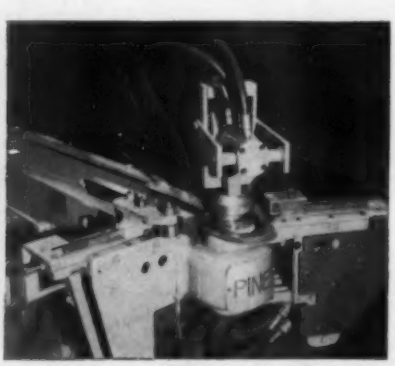
Some examples of the results of these factors are illustrated here. Whatever your metal-forming needs may be, it will pay you to investigate bending the PINES WAY. For assistance on your jobs or a cost analysis, call on Pines without obligation.



D-SHAPED STEEL CHANNEL—Unique tooling permits edge-bending without closing the ⅛" slot. 37° bends are made on a 9" inside radius to form side rails for playground slides. Done on a Model 1¼ Bender.



SQUARE-TUBE VEHICLE FRAMES—Bending of SAE 4140 steel tubing, 3" square x .239" wall on 10½" radius is done on this Model 4 Bender. Tooling illustrates use of compound die for clamping on bent section.



FLAT STEEL BARS—Three ¾" x 1" bars are bent in one operation to 160° on this Model 1 Bender. A split die actuator opens the dies for easy removal of the pieces. Bends are smooth and wrinkle-free.

PINES ENGINEERING CO., INC.

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PRODUCTION ENGINEERING SHOW

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PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY

Talking Shop...

Radiation Report

ONE OF THE FIRST atomic energy plants, built during World War II, is the one at Hanford, Washington. During this time every employee or visitor who enters any of the plant's eight limited areas wears a personal metering device to measure the beta and gamma radiation to which the person is exposed. Results are accumulated on data processing machines.

A report analyzing accumulative radiation exposure has just been made. Of the 7,803 people employed by General Electric at the end of 1959, more than two-thirds had accumulated less than one percent of the maximum permissible dose, more than 90% had accumulated less than 10% of the maximum and no worker had exceeded one-third of the permissible dose.

Handling Problem

A 400-TON die casting machine was recently installed at the Briggs-Shaffner foundry in Winston-Salem, N C. The machine, weighing 25,000 lb, arrived by truck and created a handling problem that neither truck nor plant could handle. Emil Shaffner called a railroad to see if the machine could be transferred to a railroad car and run in on the plant siding. No luck; the railroad said there wasn't a crane within 100 miles big enough to handle it.

The solution was ingenious. Shaffner called in a local nursery noted for its ability to handle big trees. The nursery crew jacked up the machine and put timbers under it, then rolled it off the truck and into position in the plant. Obviously they grow their trees big in Piedmont North Carolina.

Big Flywheel

A 68-TON STEEL FLYWHEEL, 13 ft in diameter, will store energy for a particle accelerator now being built at Argonne National Laboratory. The flywheel will spin at about 900 rpm and generate power in surges of 117 million watts for the atom smasher—one surge every 4 seconds. Because most of the energy will be stored in the magnet and reclaimed to drive the flywheel, it will take *only* 10 million watts to keep it going. We say *only* because at the start, it will require 700 million joules (watt per second) to start the flywheel and bring it up to speed. Allis-Chalmers is building the power supply unit.

Tapping Carbide

TAP BREAKAGE has been a real problem in tapping small holes in the machinable carbides. Here's the procedure developed at Chromalloy to tap Ferro-Tic C: First, grind off most of the crowns on each flute, leaving only about 1/32 in. of the original tap thread. This reduces the drag on the tap. Second, drill the hole slightly oversize for about 50 to 60% of thread, and counterbore as much as possible. Aim for the minimum thread length that will do the job. Third, use only a plug tap, not a starter tap. With a heavy bite on the first cut, glazing of the surface is avoided. Glazing will make subsequent cuts difficult, perhaps impossible. Finally, use a viscous sulfur-base cutting compound.

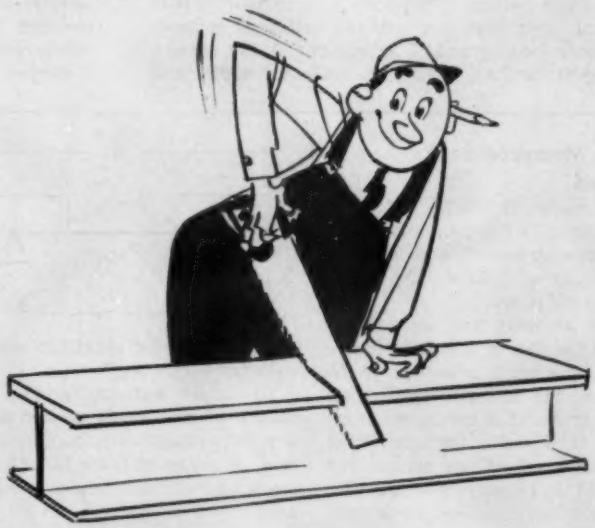
Speed Routing

WINDOW CUTOUTS on the 707 have to have a bevel on the inside of the skin to provide a seat for the seals. These chamfers vary from 33° to 45°, depending on skin thickness. At Rohr Aircraft in Chula Vista, where these are produced, the practice has been to cut the chamfer by hand with a rotary file.

Now it is done with a light hand tool devised by Stan May and Ed Osher which adjusts to the part by angle and depth of cut. The tool weighs 1.5 lb and has a wing-nut to set the angle much like the one on the portable circular saw in your workshop. A standard air-powered router is mounted in the tool which can "follow-around" the cutout in shorter time and with greater accuracy.

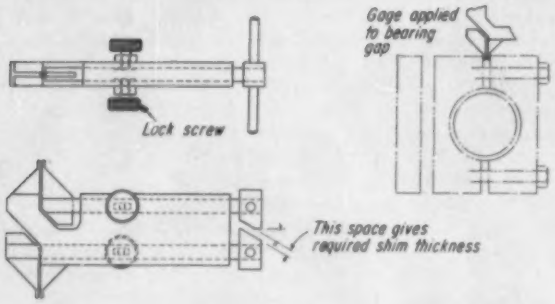
Practical Steel Catalog

HABIT BECOMES custom and custom becomes tradition and so it endures long after the reason is gone. This rather obvious thought occurs to us because of a remarkable steel catalog we saw recently. Published by a steel warehouse in Detroit, this catalog lists assorted sizes and shapes and gives the price by length instead of by weight. Instead of calculating the weight of the piece you want, and then computing the price, you read the price per inch directly from the catalog. This should be handy for small lot purchasing and we salute Nixon Steel Service, Inc, 2843 Hilton Road, Detroit, for the first catalog of this type we have seen.



Practical Ideas...

Compensating Shim Gage Eliminates Calculation Error



The compensating shim gage illustrated eliminates the necessity for trial and error bearing cap assembly and disassembly to determine the correct shim thickness. Formerly it was necessary to use a feeler gage on each side of the bearing gap, add and average the distance, then apply shims of the resulting thickness to both sides. This process might require several trials, and at any of several steps an error might occur.

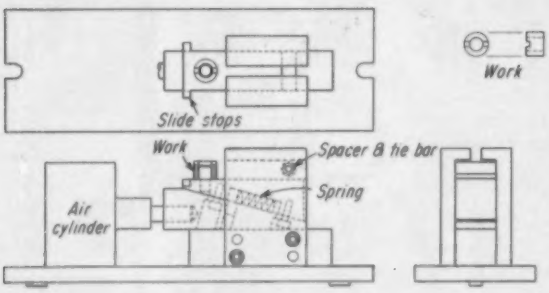
With this gage, the thickness is determined automatically and is not subject to calculation errors. Each pair of gaging fingers is expanded and secured in turn on opposite sides of the bearing shim gap. The resulting space between the angular blocks of the gage is equal to one half the sum of both shim gaps.

This result is produced because the perpendicular distance between the two blocks will increase by one half the distance moved by a pair of gage fingers. Enough shims are placed between the angular blocks to fill the space and are then inserted in the bearing-shim gap. An identical group of shims is inserted in the opposite side.

The gage is designed so that as each pair of finger gages is expanded one angular block will move upward, the other downward. The maximum travel for both blocks is identical. To insure accurate readings the block faces must initially be flush, also the lock screw must be securely fastened after a gap has been measured.

Jack A Funcke, tool designer, Allis-Chalmers Mfg Co, Cedar Rapids, Iowa

Air-Powered Jig Improves Milling Accuracy



When precision milling is required, it is sometimes difficult to find a jig that will provide sufficient support with accurate positioning. For this particular case, a slot had to be cut in a bushing to an exact depth, and in line with the center. The above drawing illustrates the milling jig designed for the job. It has three principal parts, an upper wedge, a lower wedge and a frame. Clamping action is achieved by an air cylinder.

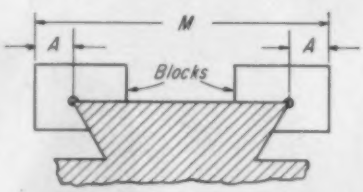
In operation an un-slotted bushing is slipped onto the pin on the upper wedge while both wedges are withdrawn from the frame. Air is let into the cylinder and both wedges begin moving into the frame. A compression spring between the wedges prevents them from riding up on each other until the lugs on the top wedge contact the face of the frame, stopping the wedge. The lower wedge continues to travel, causing the unit to expand until the bushing is snugly clamped against the inside top of the frame. Milling can then proceed with the bushing firmly clamped and accurately positioned.

Berton Leavitt, Lincoln, Nebraska

Dovetail Measurement Simplified

The customary method of taking measurements for dovetails over rods is sometimes awkward and has the added danger of introducing error through calculations.

A more accurate and convenient method is the use of a pair of hardened and ground blocks cut to fit the faces of the dovetail. Dimension A on the drawing is measured from the end of the block to the theoretical intersection point of the corner and is made to some easy-to-work-with dimension. This number is stamped



on the blocks for identification along with the block angle.

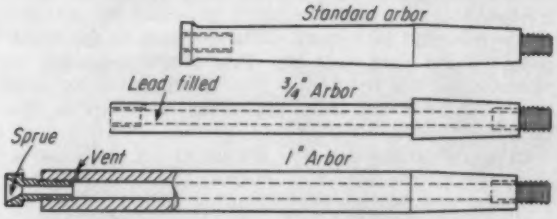
To insure uniformity, the blocks should be first made in one piece to any convenient length, then cut in two. A series of these blocks can be made up for those angles most often used.

When using the blocks, add twice dimension A to the required dovetail size, for a total distance M. When the dovetail is milled to the approximate required dimension, the blocks are applied. They are then measured across the faces to see how closely dimension M is approached. This process is continued until the correct size is achieved.

Female dovetails can be measured with the same blocks, with the exception that twice dimension A is subtracted from the given size to get distance M.

M W Loftus, Chicago, Ill

Lead-Filled Grinding Arbor Ends Vibration Problem



A job required grinding holes 10 inches deep. This was too great a distance for the original arbor on the grinder, so a longer one was made. Unfortunately, the added length caused serious vibration which broke the grinding wheels.

It was known from experiment that weighting the arbor with lead would damp out the vibration. A lead ring was placed around the arbor next to the wheel which worked temporarily, but an adequate method of attaching this weight could not be found.

The solution was found by placing the lead inside the arbor. A space for the lead was made by drilling a 5/16 inch hole through the 1 inch diameter arbor. The wheel end of the lead chamber was closed with an allen set screw which was placed in a ⅜-in. tapped hole. For ease of pouring the lead, the head of the set screw was counter-sunk to act as a sprue after the screw had been drilled through at the largest diameter possible. This hole size was limited by the root diameter of the screw. The opposite end of the arbor was sealed with a stud screwed into a 7/16-in. tapped hole. It was permanently fixed in the hole to project from the arbor end a sufficient distance for locking it in the spindle.

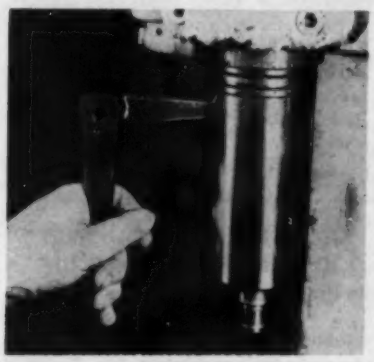
To allow air to escape from this chamber as the lead was poured, a 1/16-in. hole was drilled at the wheel end, at the base of the threads. This hole caused no weakness in the arbor.

After fastening the arbor in an upright position, the molten lead was poured into the arbor through the set screw funnel. When the lead hardened, the set screw was removed and the threads cleaned by retapping.

After re-attaching the arbor to the spindle, the grinder was ready for efficient operation once more.

In addition to the arbor described above, another shorter arbor was also made for the same grinder. This second arbor had a diameter of ¾ in. and a tapped hole of ¼ in. in the wheel end. The center drill and spindle end were the same as the first arbor, 5/16 and 7/16 in. respectively. The method of leading was also the same.

Benjamin Lechler, St. Louis, Mo.



Combined Drill Drifts Are Easier to Use

Here, a large and a small drill drift are welded together into an L-shaped tool. This simple innovation has several advantages. First, seldom is a hammer necessary to unseat a drill because of the added leverage obtained. Second, two hands are enough to remove a drill; one to jar it loose and the other to catch the drill. Third, the drift won't be sent flying through the spindle slot as is often the case when you are using a hammer on a plain drift.

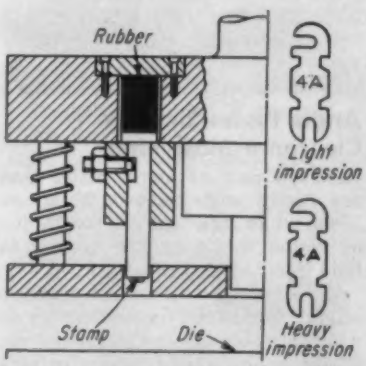
Then too, the convenience of having the choice of either large or small drift readily available is a distinct time saver. This is particularly evident when a drill is sleeved. It is then necessary to use the smaller drift in removing the sleeve after the assembly has been removed from the machine spindle. As shown, the tool is inserted in the quill and pushed toward it to dislodge the drill.

H J Gerber, Stillwater, Okla

Rubber Cushion Improves Blanking Operation

While blanking small parts from thin material (0.002 to 0.003 in.) such as fuse links, it is difficult to maintain a uniform depth of stamping impression. Oil pressure fluctuations in the power press bearing alone can cause a variation of several thousandths in bottom dead center during operations. This may cause a too heavy impression or none at all, and a heavy impression is likely to weaken the material at the punched section. This will also dull the stamp since the punch and die have very little clearance and overtravel will result in impact on the stamp.

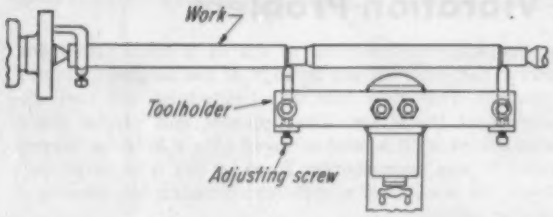
To overcome this fault, a length of round rubber was used to cushion the stamp. This rubber can be cut from a round rubber section or a piece of heavy duty hose will do nicely. It should be rather hard and long enough so it is under compression when installed. A dog-point setscrew retains the stamp which rides freely in its support. The end of the stamp bears on a hardened disk which in turn bears on the rubber. Holding the rubber in the bore is a plate attached to the top of the stamp holder. Impact from any overtravel is now absorbed by the rubber, thus giving the stamp longer life and more uniformity to the impressions.



William Fox, West New York, NJ

Practical Ideas...

Long Shafts Turned in Half the Time



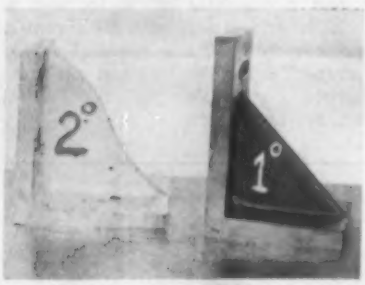
Turning long lengths, such as shafts, usually take a great deal of time. This is idle time for the operator who has only to watch the tool move along the work. With the simple setup illustrated, this idle time can be cut in half.

A piece of cold rolled steel, heavy enough to support the two tool bits rigidly, is cut to a length slightly longer than half the length to be turned. Square holes are broached at each end of this cross piece to fit the size of the bits used. The distance between the holes should be a little shorter than half the length being turned. Capscrews in the cross piece secure the bits. Independent tool adjustment is provided by a capscrew mounted in a small plate fastened to the cross piece behind each tool bit. This entire assembly is mounted on the compound rest of the lathe by two heavy 'T' bolts and nuts, spaced as far apart as the compound rest allows.

In operation the two bits are set to cut at the same diameter by the adjusting screws. Once the bits are properly aligned, the work is turned to the proper diameter in the usual manner. Two identical pieces can in this way be made and when machining is complete, the pieces are separated with a hacksaw and faced off. A formed rest should also be used when necessary.

This arrangement may be adapted to a variety of jobs. For example, stepped shafts could be made by the addition of more tools.

Detlef Schilling, Ontario, Canada



Angle Plates Simplify Clearance Machining

Here's a pair of angle plates that are really angle plates. They are identical to standard ones with the exception that they are ground to hold items at 1° or 2° off 90°.

These are the two most common angles used in our shop where we do a considerable amount of mold work. Plates ground in this way eliminate the nuisance of shimming, either under one end of the plate or under the edge of the work.

Clearance angles are easily ground on the surface grinder with the aid of these plates, before or after the work is hardened. Certain compound angles are easier to produce and the firmness while machining is a relief to the man on the job. Fancy sine tables and shaky setups are a thing of the past.

A plate is prepared in the same manner as a standard plate, all sides, edges, and faces being square with each other. It is then set up and ground to the angle desired. After painting the back side in an easily distinguishable color to prevent the plate being used as a standard square plate, the degree angle is marked on the gusset. Our 2° plate, which is actually 88°, is painted bright yellow and the 1° plate green.

Carl S Frank, Clark, NJ

Altered End Mill Improves Machinability

After forming 50 pieces of CR sheet steel, it became necessary to mill 3 parallel ⅛-in. slots and a rectangular opening in each. Some attempts at regular milling procedures with standard end mills were tried but abandoned as unsuited.

A simple solution was found in a minor alteration of two-fluted end mills. Grinding 118° drill points on each made them ideal for plunge cutting through the thin material. This has lead us to wonder why this type cutter has not been offered along with ball and square-end end mills.

B H Doyle, assistant superintendent, Nashau Package Sealing Div, Nashua, New Hampshire

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William Bonham
Pompano Beach, Fla
Won $25 for his idea:

HELICAL BORING TOOL GIVES GOOD FINISH AND LONG LIFE
in the May 30, 1960 issue

AN EXTRA $25 will be paid for the best Practical Idea in each issue of *American Machinist/Metalworking Manufacturing*. Selection of the winning idea is made by a group of our readers.

PAYMENT—in addition to regular rate for item published—will be made as soon as tabulations are completed. The winner or winners—in case of a tie when duplicate prizes will be awarded—will also be announced in these pages.

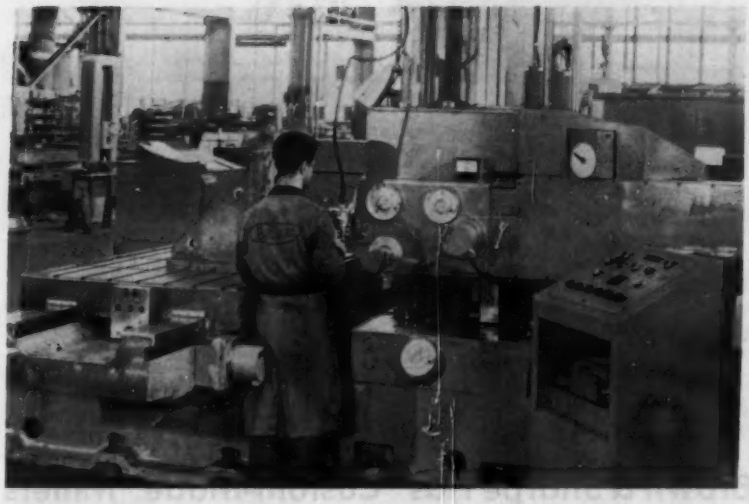
JUDGES . . . are a group of *American Machinist/Metalworking Manufacturing* readers who select articles they prefer in a particular issue. This group changes entirely with each issue and represents a true cross-section of our readers. Their decision is accepted by the editors, without reservations or bias, as final in each case.

REQUIREMENTS—All items appearing in the Practical Ideas pages are eligible. They must be submitted by the originator on an exclusive basis. Do not worry about your shortcomings as an author, draftsman, or photographer—every item will be edited in accordance with *American Machinist/Metalworking Manufacturing* standards. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER—Anyone may enter except employees of McGraw-Hill Publishing Co. Inc, and those of its advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER—Send all entries to: "Practical Ideas Editor" *American Machinist/Metalworking Manufacturing*, 330 West 42nd Street, New York 36, NY.

New Shop Equipment
Materials and Parts



Bullard Horizontal Mill Has Two-Finger Controls, and Will Take Tape Systems

The Dynamill, a horizontal boring mill that can be controlled, literally, by only two fingers, is available in 3-, 4,- and 5-in. spindle sizes. The operator completely controls the machine with a single pendant which contains four buttons and a pistol grip. Because the pendant is supported from a flexible steel cable, the operator can move about freely and station himself wherever it is most convenient.

An important feature of the Dynamill is the provision for easy and accurate positioning of work and tool. Using clock-type position indicator dials and four traverse rates which are controlled through the pendant, the operator can position the work and tool with the fingers of one hand.

"Floating" pendant and indicator dials give operator two-finger control over machine movements and a quick, accurate indication of tool and work position

Inherent in the design of the Dynamill is the provision for adding tape control at any time. In cases where numerical controls are applied (machine illustrated has a GE Mark I system), the dial measuring system provides an accurate readback making it possible to check the reliability of the tape in-put data.

The wearing surfaces on the ways illustrate an original approach. They are strips of bandsaw steel 0.040 in. thick that have been plated with a 0.0015-in. hard chrome plate. (See *AM/MM*—July 27 '60, p2.)

The locations of the head, table, saddle, and spindle are each indicated by a separate three-pointer, two-scale dial (see illustration), reading from 100 in. down to a thousandth of an inch. Each of these dials is resettable; therefore the operator can choose any zero reference point.

The pendant has an ingenious rotating turret mounting four buttons. With these buttons, all directions of movement of head, table, saddle, and spindle can be controlled. In one position (as illustrated) the buttons actuate movement of head up, table right, head down, and table left. By rotating the turret 45°, four different movements are actuated: spindle retract, saddle advance, saddle withdraw, and spindle extend.

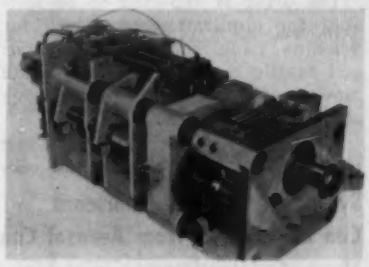
The speed of traverse, and the engagement of feed, are controlled by pulling or pushing the trigger on the pendant. By the amount of pull exerted, the operator can select from four different traverse rates, in direct proportion to the amount of finger pressure.

Twenty-eight spindle speeds are available on headstock and feed rates are infinitely adjustable from 0—0.125 ipr and 0—108 ipm. The feed rate may be increased or decreased while tool is cutting.

The Dynamill can be supplied in five standard table sizes ranging from 36 x 60 in. up to 60 x 132 in., in five standard bed length from 60—144 in., and in four ranges of head vertical travel from 50—86 in.

The Bullard Co, Bridgeport 9, Conn

MORE DATA? Circle 51, inside back cover



Bullard Drive Gives Constant HP over 112-1550 rpm Range

The VS drive—an infinitely adjustable drive—runs at a contsant input speed of 1800 rpm and, through a mechanical and hydraulic linkage, delivers constant horsepower at any output speed from 112-1550 rpm (a ratio of 13¾ to 1) and constant torque from zero to 112 rpm. Any desired speed within this range is selected from a single dial with pointer, and is delivered without

steps or interruptions at constant hp or torque, depending on the speed.

This is done by a combination of planetary gearing, controllable hydraulic feedback, and shiftable square-toothed clutches. This is all automatic, and speeds can be increased or decreased without stopping the table even if it is under full load.

The first production model of the drive is a 50 hp unit which is being applied to the new 46-in. Bullard Dynatrol VTL (see *AM*—Dec 28 '59, p101). It has been designed as a complete drive unit which is interchangeable with the standard headstock for this machine and can be installed as a replacement if VS Drive is found necessary after original purchase of the standard machine.

With this drive the maximum rate of shifting through the complete range is considerably faster than the rate of speed variation possible with the standard stepped-speed headstock and it is unnecessary to stop table in order to change speed. In fact, it is possible to bring the work gradually to a full stop with the tool in the cut and then accelerate to original full speed again in a matter of seconds without damage to tool or any shock whatsoever to drive.

A built-in safety device to prevent damage to both the adjustable speed mechanism and other parts of the machine is provided to function at 25% overload. This device disengages the main clutch and applies the brake, stopping the machine much faster than the operator could act manually.

The drive is expected to be suitable for application to drives for machine tools, rolling mills, paper and textile machinery, heavy earth moving equipment, and other heavy equipment.

The Bullard Co, Bridgeport 9, Conn

MORE DATA? Circle 52, inside back cover

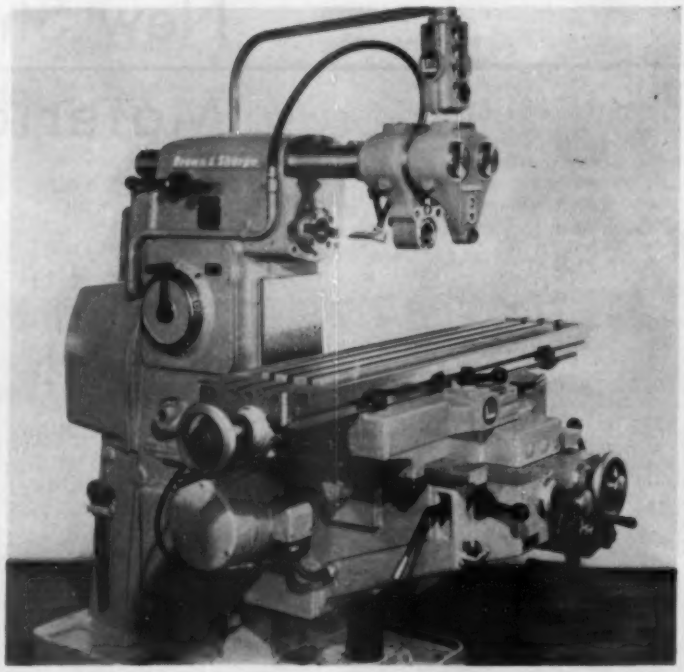
Synthetic Graphite Lubricant Can Be Sprayed from Aerosol Can

Made of synthetic graphite and specially formulated for aerosol use, Sprayon No. 204 is recommended wherever a "dry" lubricant is needed, petroleum products must be avoided, or temperatures are extreme.

According to the maker, even dispersion is gained through aerosol application. It is ideal for flat springs, die casting machines and re-assembly of moving parts.

Sprayon Products Inc, Cleveland, 3, Ohio

MORE DATA? Circle 53, inside back cover



Brown & Sharpe Has "Custom-Made" Millers For Rapid Shipment Virtually from Stock

A maximum of five-weeks delivery is planned for any combination of redesigned B & S No. 2 milling machines—plain, universal and vertical, and for sliding-head Rangemasters. Building-block design has been adopted for the standard and special components. These components will be manufactured in lots and assembled as required to suit the specific order. A purchaser can therefore get a customized machine in any one of 132 combinations, virtaully off the shelf.

The redesigned machines will cut faster and take heavier cuts than their predecessors. Size for size, they are 750 lb heavier than previous models to provide the stability, accuracy and production required under today's conditions, and to cope with exotic materials.

The No. 2 machines are built in 3- and 5-hp models with conventional speed ranges, and 7½ and 10 hp models with speeds of twice the conventional range for carbide milling. A flywheel is standard on the 5-hp model for carbide milling and is optional on the 3-hp machine.

Working surface of the table has been increased to 13 x 55 in., and the vertical travel has been increased on the 3-, 5-, and 10-hp models.

Displays at the Machine Tool Exposition will show the many built-in or optional features not found in former models:

All models are available with automatic-cycle rise and fall of the knee as optional equipment. Backlash eliminator for climb milling is also optional.

Automatic climb milling is obtained when the machine is engaged in power feed, and is released when fast traverse of 150 ipm is engaged, to prevent excessive wear of the leadscrew. Also, if normal table feed is being used, the climb milling feature is made inoperable automatically, to avoid drag.

Top of knee is inclosed with solid plate to protect the cross-feed screw from chips. There are no telescoping guards. An opening at the rear allows escape of chips and coolant to the base.

Knee lubricating system is controlled by a timer switch to provide metered, filtered oil at suitable intervals.

Conventional power feeds or completely automatic cycle arrangements are available.

An automatic cycle is available for the first time on a universal miller for cutting helices, etc. A new design of spiral head eliminates need for the short-lead attachment. Rapid

indexing is obtained by a new method of engaging and disengaging the wormwheel. Attachment has a NMTBA No. 40 taper.

Feed ranges can be conventional or optional. Feed rate can be chosen with a finger-tip selector, and gear shifting is done hydraulically. Pendant-type control gives greater operator convenience.

Brown & Sharpe Mfg Co, Providence, RI

MORE DATA? Circle 54, inside back cover

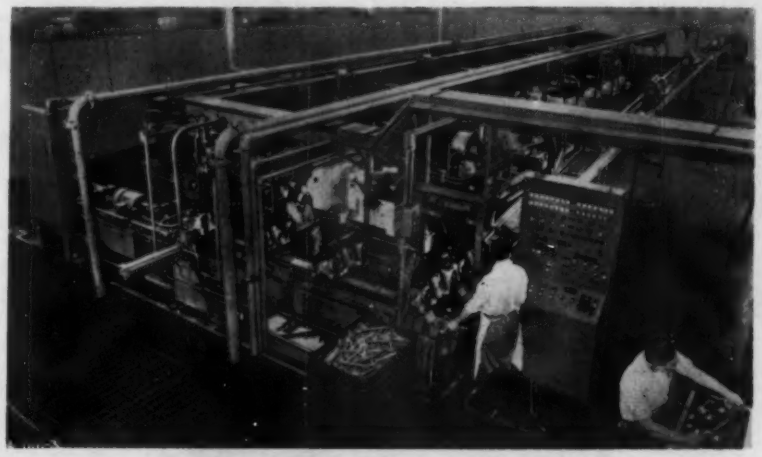
Multiple Slide and Transfer Press Halves Tooling Costs

Available in capacities of three and nine tons, this press can blank, pierce, form, and bend in one single continuous operation at speeds up to 100 strokes per minute. The manufacturer claims this multiple slide transfer press is ideal for the production of job lot quantities.

Tooling costs can be cut in half because tooling is divided into separate units. This method costs less than equivalent progressive die tooling for a single slide press. Parts are easily changed as all tool holders are individually adjustable for height. Because the blank is separated at the first station and positively held for all following operations, tolerances on finished parts are not dependent on accurate feeding of strip. As a result, there is no bending or twisting of stock.

E W Bliss Co, 1375 Raff Road, Canton 10, Ohio

MORE DATA? Circle 55, inside back cover

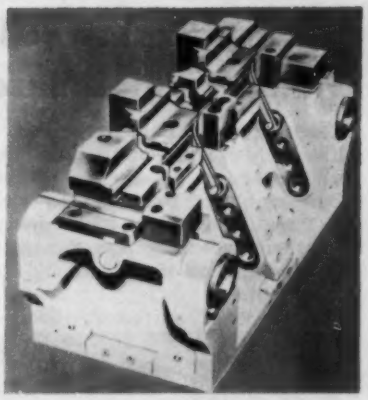


Transfer Line Based on Broaching Produces Adjustable Wrench Handles

Four sizes of adjustable wrench handles in regular and locking styles are machined on a single continuous, 27-station transfer machine installed at J H Williams & Co, Buffalo. Reported to be the world's first major transfer line built around internal and surface broaching, it is a pallet-type machine.

Each pallet holds four wrenches at a time, handling the four sizes (6, 8, 10, or 12-in.) interchangeably. Machine cycle time is slightly under 30 sec with an output rate of approximately 500 wrenches per hr. Close and consistently uniform tolerances on machining permits mating of jaws to handles without hand fitting.

The line has a total of 14 machining stations, 6 of which are multiple-machining and 8 broaching. Multiple-machining stations cover end milling, drilling, reaming, and tapping. The last station (No. 27) performs a multiple-staking operation. Loading and unloading are both done at the same end of the machine. Pallets carrying machine-finished wrench handles are passed through a wash at the end of the line and are elevated to a return conveyor which takes them back to the head of the machining line.



Since operations on the wrenches must be performed on different planes, at right angles to each other, the machine has two 90° turnaround stations. At one of these, the worm hole opening is broached to size and all working jaw-faces are surface broached at the other. Near the end of the machining line, pallet is automatically tilted to broach an angular opening in the head of the wrench body.

Colonial Broach & Machine Co, PO Box 37, Harper Station, Detroit 13, Mich

MORE DATA? Circle 56, inside back cover

Clear Plastic Coating Protects Against Corrosion and Leaves No Film when Removed

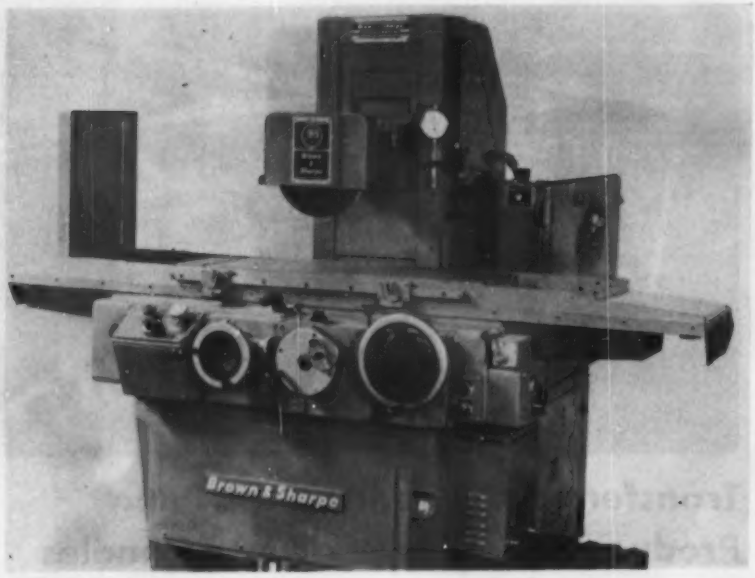
A crystal clear plastic #637, new member in the line of Hot-Melt Dip-Pak coatings, is suggested for use as a stop-off during electroplating or painting operations.

Because Dip-Pak #637 exudes no oil when left standing at room temperature, it can be used as a temporary protective coating against corrosion. No film of any type is left on metal when coating is removed.

Material is shipped as solid plastic blocks and melted just before application. The entire process takes only seconds. The material melts at 360F and may be used at 320—350 F. The #637 Dip-Pak shows no sign of corrosion after the following cycle: 16 hr at 100 F, 100% relative humidity; 3 hr at —40F; 2 hr at 163 F; 3 hr in 5% NaCl solution.

Fidelity Chemical Products Corp, Newark, N J

MORE DATA? Circle 57, inside back cover



Brown & Sharpe Builds Larger Surface Grinders with Unitized Construction

In setting up to build three larger sizes of hydraulic surface grinders, Brown & Sharpe again adopted "building-block" concepts. As with No. 2 milling machines, unitized construction enables the firm to supply 144 combinations of standard and optional features.

These three surface grinders—8 x 24, 10 x 24 and 10 x 30—bring the B & S redesigned line to five sizes. The smaller 5 x 10 and 6 x 18-in. grinders were announced during the last two years.

Unitized construction for the three larger sizes was worked out this way:

Upright, base and spindle unit—one size of each.

Tables—three sizes.

Beds—two sizes; one for the 8 x 24 and the 10 x 24, and one for the 10 x 30-in. machine.

Two types of spindle drive are available: 3 hp Oriflex (round-blet) or 5 hp direct drive.

Features built into the grinders or available on option are supplied for faster stock removal and operator convenience. Rapid power positioning of longitudinal movement at 150 ipm and vertical movement at 150 ipm are standard. Table speed is increased to 125 fpm and cross feed increments to ½ in. maximum. Vertical capacity has been increased to 14 in. under a 12-in. wheel. Transverse movement on the 8 x 24 in. machine is 14 in.

Optional features include: automatic slot or surface grinding attachment, vertical positioning attachment, over-the-wheel truing attachment.

Brown & Sharpe Mfg Co, Providence RI

MORE DATA? Circle 70, inside back cover

Gisholt Superfinishing Unit Features High Flexibility

Model 51B superfinisher consists of a headstock, a tailstock and a vertical platen mounted on a bed which is enclosed on three sides. The platen holds a self-contained reciprocating unit on which either one or two honing-stone-carrying quills can be mounted.

Work can be held between centers in a chuck, a collet or a fixture, or supported on rollers. A second vertical platen can be added to permit finishing of as many as four different areas simultaneously. The stone quill can be moved four inches longitudinally for work that requires positioning of the upper head and for ID work. Machining cycle is completely automatic.

Gisholt Machine Co, 1245 E Washington Ave, Madison 10, Wis

MORE DATA? Circle 71, inside back cover

Bridgeport Brass Alloy Uses Mercury to Combat Corrosion

Alloy 77, for condensers and heat exchanger tubes, is first commercial copper base alloy to incorporate mercury. It has unusual resistance to biofouling, resists dezincification, and has good resistance to other forms of corrosive attack.

It is currently available in condenser tube sizes ranging from ⅝-1 in. OD and in wall thickness ranging from 0.049 in. (18 BWG) to 0.065 in. (16 BWG). Price falls between admiralty and aluminum brass.

Bridgeport Brass Co, Bridgeport, Conn

MORE DATA? Circle 72, inside back cover

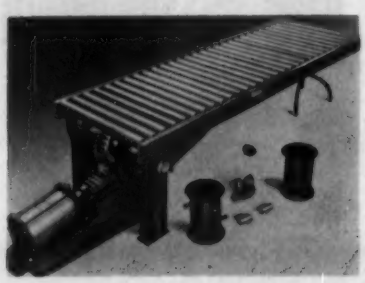
Time-Speed Recorder Spots Trouble in Machine Operations

Annis Time-Speed Recorder is a graphic recording instrument that helps spot hidden trouble in machine operations and processes by timing short duration events to millisecond accuracy even at slow chart speeds. It is reported to be the only instrument of its type for monitoring automated operations that provides split-second timing along with time-of-day information. Time markings along edge of the chart show time of day any event occurs while sweep of the recording pen across the chart displays duration of the event. Timing is accomplished by closing or opening an electrical control circuit.

Standard chart speeds of ¾, 1½, 3, 6, and 12 in. per hour and per minute are provided. Sweep time scale ranges of from one second to one hour are available. Special charts with scales for measuring speed (as an inverse function of time) are also offered. A chronograph pen can be added to permit simultaneous recordings of the time other related events occur. The recorder operates on 115 v 60 c. Price is $975 fob, complete with accessories.

R B Annis Co, 1101 N Delaware St, Indianapolis 2, Ind

MORE DATA? Circle 73, inside back cover

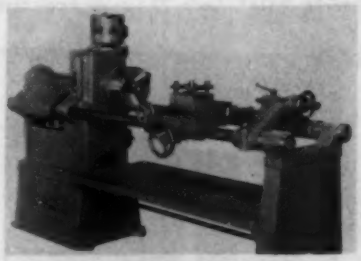


Oil-Air Operated Lift Gate Designed For Heavy-Duty Work

Units are available equipped with roller or wheel conveyor gates up to 10 ft long and 36 in. wide. Mechanism is so arranged that complete control for raising or lowering is obtained through use of control valves. Remote control buttons can be used for operating from a distant point.

Sage Equipment Co, 30 Essex St, Buffalo 13, NY

MORE DATA? Circle 74, inside back cover

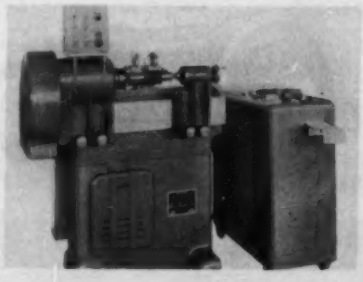


New Oil Grooving Machine Does Internal, External Work

Machine, made by Kitchen & Wade of Halifax, England, will do external work up to 5 in. in diameter and internal work up to 7½ in. in dia. Infinitely variable stroke is from 0 to 12 in. Pushbutton controls simplify operation and there are rigid locks to all adjustments. Crank drive may be disengaged by a hand lever so that the saddle remains stationary for cutting internal or external ring grooves. Floor space is 7 ft 8 in. by 2 ft 3 in.

Dist by Fidelity Machine Tool Co, 309 Vine St, Camden 2, NJ

MORE DATA? Circle 75, inside back cover



Star Precision Lead Analyzer Checks, Records Measurements

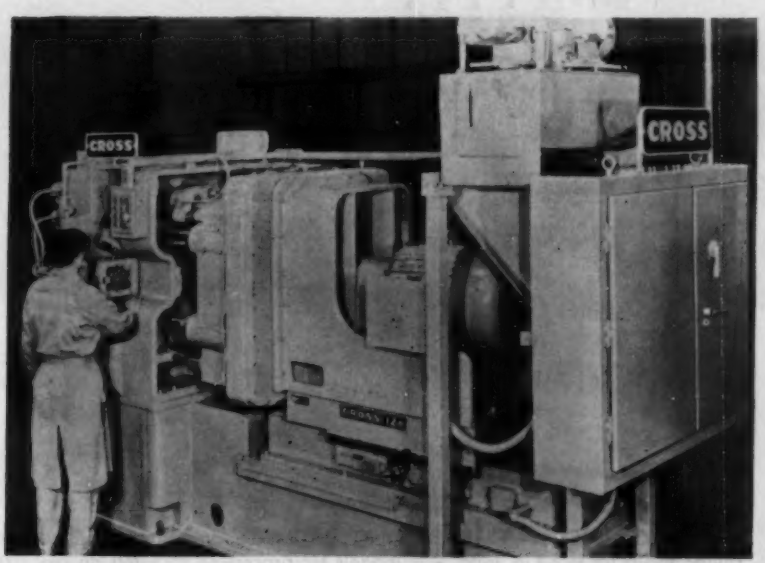
Universal analyzer inspects and records (electronically) lead measurements on hobs, helical gears and splines, worms, screws, cams, taps, form milling cutters, and multiple thread milling cutters. Lead of both sides of a thread is checked and charted simultaneously.

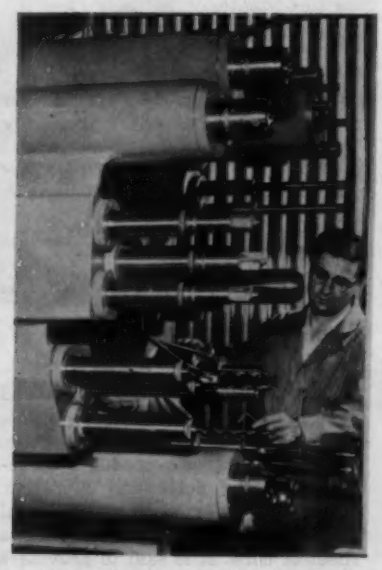
Spindle and slide timed relationship is provided by change gears, which enable the selection of leads from 0.001-1000 ipr.

Analyzer handles tools or parts up to 16-in. long and 9-in. dia. Maximum transducer slide travel is 8 in. Work height is 41½ in. Floor space of machine is 30 by 44 in., and amplifier-recorder unit takes 16 by 31 in. floor space.

Star Cutter Co, 34500 Grand River Ave, PO Box 376, Farmington, Mich

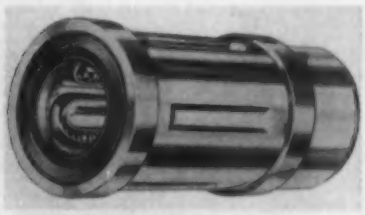
MORE DATA? Circle 76, inside back cover

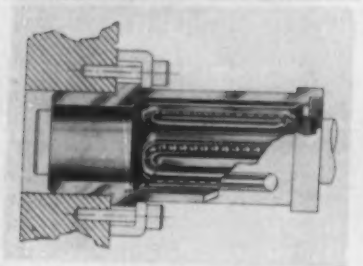




TRUNNION MACHINE used for processing combination clutch and brake master cylinders, which require drilling, spotfacing, hollow milling, and reaming. The machine has several different feed rates for individual tools or groups of tools mounted on a single hydraulic feed unit. Eight accelerated spindles are used on this machine so that individual operations can have optimum feed rates. Setup man has his right hand on one of the special quills. With this design, the solution to the problem of mixing different types of operations on a trunnion is comparatively inexpensive—*The Cross Co, Park Grove Station, Detroit 5, Mich*

MORE DATA? Circle 77, inside back cover





Linear Ball Bearings Designed For Use with Existing Die Sets

A special linear ball bearing, called a Ball Bushing, has been designed specifically for use on die sets. They are interchangeable with standard plain bronze or steel bushings in existing dies, and the bore diameter is dimensioned to fit standard guide pins in use today.

Because these bushing replacements make anti-friction die sets, they improve die performance of dies and reduce toolroom costs. They prevent all cocking and binding, the punch holder "floats" on and off, and the free rolling ball bearings enable the tool marker to actually "feel in" the fit of mating parts.

The construction of these ball bushings makes seizure on guide pins impossible. As dies are a major investment, the prevention of seizure smash-ups is as important as the improved die performance and the reduced toolroom costs provided by the bearings.

Thomson Industries, Inc, Manhasset, N Y

MORE DATA? Circle 78, inside back cover

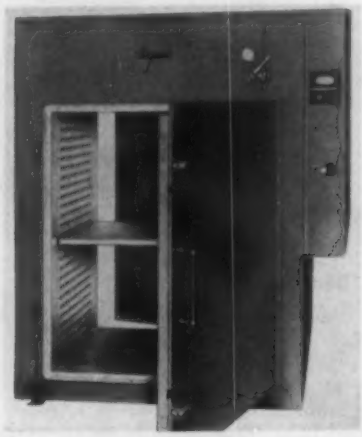
Damping Compound Reduces Structurally Borne Noise

Korfund Vibrodamper Compound is a viscoelastic material which, when sprayed or trowelled onto metal plate, greatly reduces structurally borne noise and vibration. Material is reported to render metal plate acoustically equivalent to a sheet of cork. It is said to provide a vibration decay rate of 3 to 5 db per second and to be 100 times as effective for vibration damping as a ½-in.-thick, 6-lb density glass fiber blanket.

Compound, handled like a coat of paint, dries to a smooth finish, is non-toxic, and non-flammable. It is resistant to alkali, grease, gasoline, and aliphatic oils, and does not become brittle or change with age.

Korfund Co, 48-39B 32nd Pl, Long Island City 1, NY

MORE DATA? Circle 79, inside back cover



Industrial Ovens with 2 Doors Convenient for Bulky Objects

Since they are equipped with both front and back door openings, these industrial ovens are convenient for loading bulky products and test items for drying, curing, and other heat treating processes. Loading is eased further by a foot-operated release.

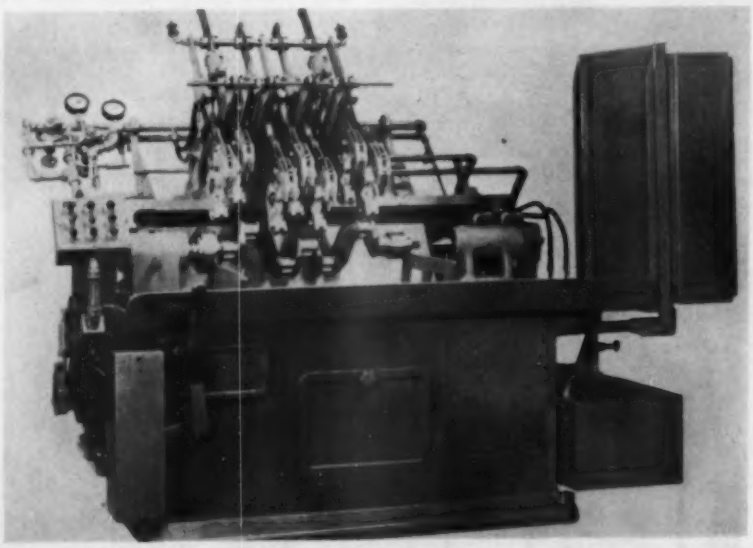
Chamber floor is reinforced to withstand 500 lb workload. Eye-level controls include an adjustable automatic thermostat for maintaining temperatures within 5F of desired value in the 95-500F range. An oven-temperature controller prevents chamber temperatures from exceeding thermostat settings.

Electric Hotpack Co, Inc, 5035 Cottman St, Philadelphia 35, Penn

MORE DATA? Circle 80, inside back cover

AIRITER, containing a true reciprocating air motor, will write on almost all materials. It makes a readable mark down to 1/32 in. high—*Rotor Tool Co, 26300 Lakeland Blvd, Cleveland 32, Ohio*

MORE DATA? Circle 81, inside back cover



LINE OF CRANKSHAFT FILLET ROLLING MACHINES now comes in sizes for rolling shafts up to 84 in. long, with models for processing all fillets on any size or style crankshaft. Designed for high production, these machines turn out up to 45 pieces per hr. A unique feature of this line of machines is that no master crank is needed; the heads automatically follow crankshaft bearing surfaces, and therefore no setup time or major adjustment is necessary when changing from one crank to another with a different stroke—*The Foote-Burt Co, Cleveland 8, Ohio*

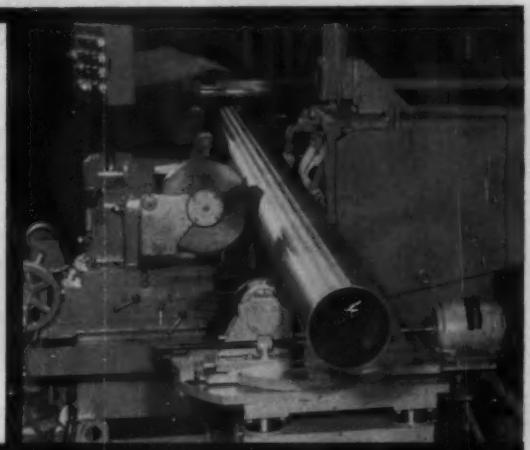
MORE DATA? Circle 82, inside back cover

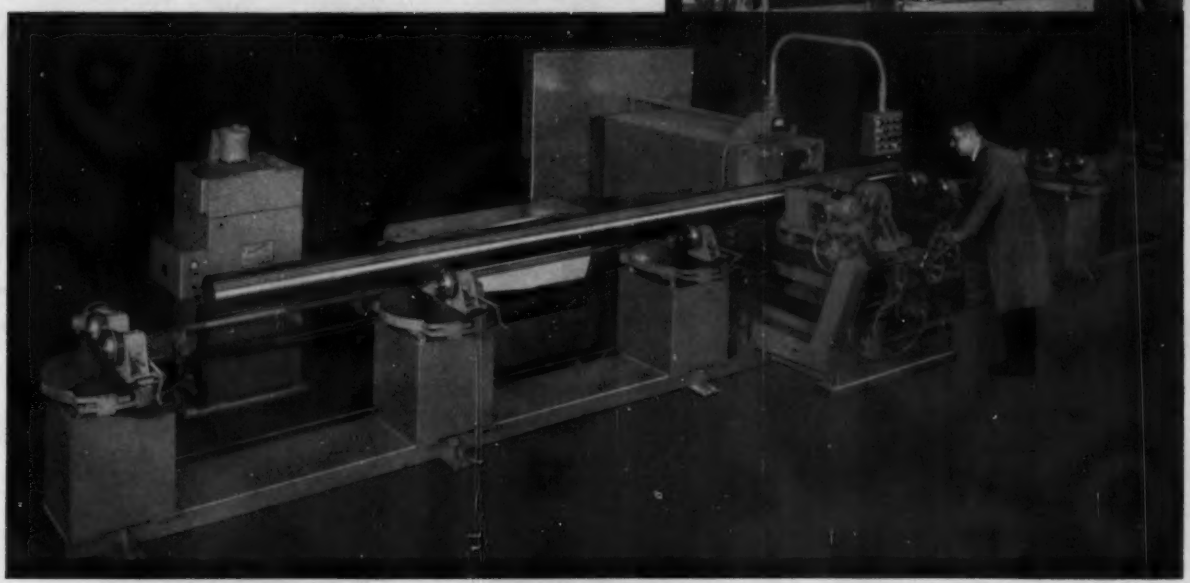
BELT GRINDING: combines rapid stock removal with improved quality on roughing and finishing operations

Take the new Sundstrand-Engelberg Model 8132-HD centerless belt grinder; it can handle stock from3/32″ to 8-1/2″ dia. at through-feed rates from 1′ to 40′ per minute — and produce to high finish and tolerance requirements. Also, because stock through-feeds in either direction, non-productive time on multiple-pass work is eliminated.

One user is removing .020″ stock per pass on 8″ dia. steel tubes at a through-feed rate of 7′ per minute.

For more information, send for literature and ask for a Sundstrand "Engineered Production" analysis of your final finishing operations to determine the economic benefits of abrasive belt grinding on your jobs.





CHECK THESE FEATURES OF ABRASIVE BELT GRINDING:

GREATER PRODUCTION. Because of higher speeds, more grinding area, simpler set-ups, and no time loss for truing or wheel dressing, production is higher. Belts are sharper due to grain orientation. Flexing works out chips for better cutting edge exposure. Change-over time is reduced to a few minutes. Roughing and polishing can be done with only one setup.

• • •

MORE VERSATILITY. Any material can be machined: metallic or nonmetallic. They're efficient for either mass production, small lots, or toolmaking. They're more easily automated than many other machines.

• • •

LOWER COST. Remarkable production lowers costs per piece. You don't need skilled labor for their operation nor elaborate, expensive fixtures. Belt grinders cost less initially than most other finishing machines. Also, belts are less expensive than wheels and are much easier to store and handle.

• • •

SIMPLE AND SAFE. Abrasive belt machining is safer because wheel hazards are eliminated. Operator fatigue is reduced and chips present no problems. Belts are easily changed by inexperienced personnel.

SUNDSTRAND ENGELBERG

SUNDSTRAND-AMERICAN BROACH

ANN ARBOR, MICHIGAN • DIVISION OF SUNDSTRAND CORPORATION

Two Lathe Models, with All-Geared Headstocks, Have 12 Spindle Speeds

In addition to all-geared headstocks, C&J Master Model lathes incorporate features usually found only on higher priced models. Price of the lathes, made in two sizes, the GH 16 in. and the GH 18 in., is $3240.

Twelve spindle speeds from 20 to 900 rpm are obtained through two speed handles. Gears are heat-treated alloy steel and shafts are accurately ground special steel. Taper nose spindle (standard LO type) is mounted in precision taper roller bearings. Headstock is lubricated by splash system with all parts running in a constant oil bath. Oil level is checked by a window indicator.

Improved friction type clutch and brake instantaneously controls the spindle, allowing the motor to run continuously. Clutch and brake control handles are conveniently placed and the apron control handle on 10, 12, 14, and 16-ft lathes permits spindel control from the apron at any position along the bed. At 100 rpm the front spindle bearing takes a 6622-lb radial load, a 5227-lb thrust load. Rear spindle bearing takes a radial load of 5681 lb and a thrust load of 3776 lb.

Carroll-Jamieson Machine Tool Co, Batavia, Ohio

MORE DATA? Circle 83, inside back cover

Allaco Line of Epoxy Resins Designed for Foundry, Tooling

A complete line of epoxy resins has been especially formulated for the foundry and tooling industries. All of them cure at room temperatures, and most, according to manufacturer, hold close dimensional stability during this cure. Briefly, these new products are:

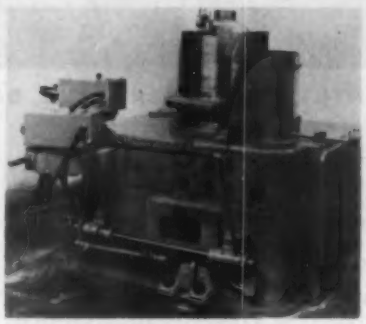
- Foundcast 101, for molds and patterns, particularly well-suited for small items where intricate design and surface dimensions are important;
- Sandbind 201, for making superior molds for casting epoxy duplicates;
- Facecoat 301, which is easily applied with a brush, for use with molds and patterns;
- Multicast 401, which can be cast in fairly large volumes, for making epoxy jaws and chucks;
- Layup 501, to make molds and patterns with fiber glass layups.

In addition, Allaco has developed a fluoro-carbon dispersed in a liquid vehicle, Surepart, which has the property of non-sticking on all types of surfaces.

Allaco Products, 238 Main St, Cambridge 42, Mass.

MORE DATA? Circle 85, inside back cover

German Wire Drawing Machine Prevents Capstan from Slipping

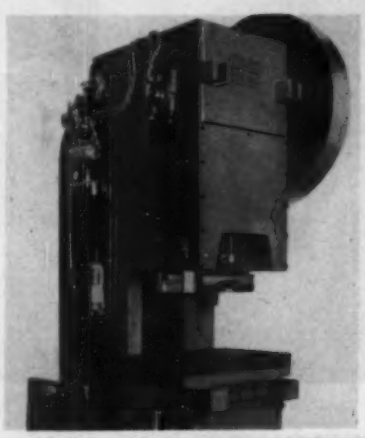


Wire drawing bull block, made in Germany, is vertical double-deck machine with differential speed compensation. Made by Malmedie & Co, the machine has an advantage over conventional ones equipped with a rigid double-deck capstan in that both sections of capstan can operate without slip. This is of great importance when drawing sensitive material or if different reductions are used.

Differential drive automatically selects optimum speed ratio of capstans for any given drawing condition, equilibrium being provided by the wire which is subject to back-pull. Drawn wire is free of torsion stresses.

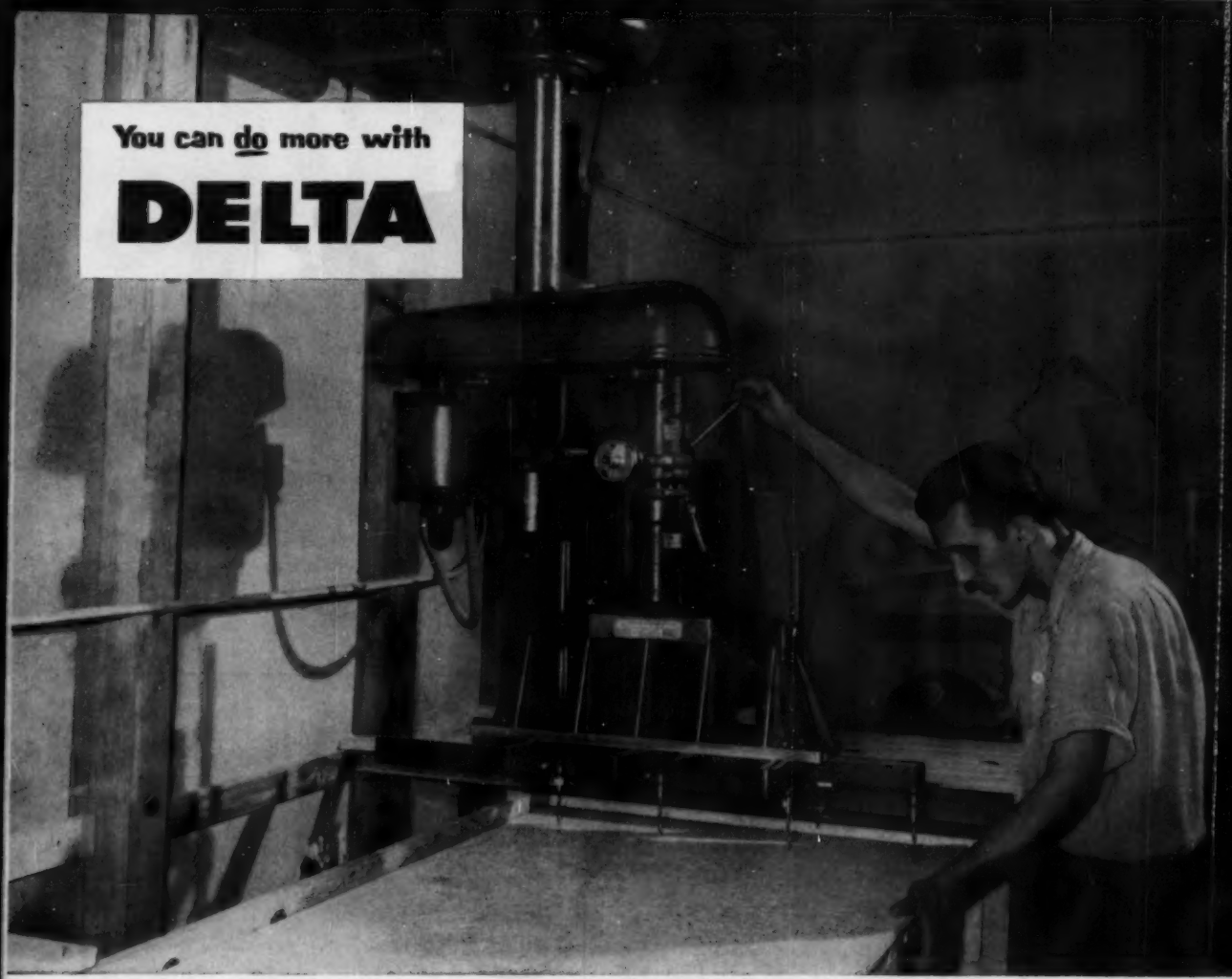
Dist by Straus-Artys Corp, 45 N Station Plaza, Great Neck, NY

MORE DATA? Circle 84, inside back cover



Welded Frame OBI Presses Offered In 75 to 200-ton Capacities

In addition to welded-frame design, new line incorporates box-type slide for greater production accuracy and more dependable barrel-type slide adjustment. Maintenance costs are reported to be reduced by the design which combines the advantages of welding and the use of steel plate to achieve a stronger structural frame. Presses can be inclined in three different positions to accommodate various types of dies and at the same



Costs cut 50% in multiple hole drilling

Delta 17″ Drill Press, also 20″, 15″, 14″ and 14″ Super-Hi Sensitive. Available in floor, bench and multiple-spindle models.

Suspending a standard 17″ Delta drill press from an angle iron wall bracket over a table not only *doubled* productivity, but resulted in greater accuracy in wide panel drilling work for S & S Visual Company, a Brooklyn display firm. Use of a Commander multiple spindle drill head permits simultaneous drilling of up to 15 holes in a line 35″ long. Avoiding costly single-purpose equipment, the firm used versatile, standard Delta components for this relatively inexpensive installation.

Every model in the world's most complete drill press line offers the power, precision performance and ruggedness that have set industry standards for years. Delta drill presses give you better value for your money—they cost less to buy, less to operate and less to maintain.

To match the tools to *your* needs, visit your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages). And for a FREE Delta Industrial Catalog showing 61 machines, 302 models, over 1400 accessories, write: Rockwell Manufacturing Company, Delta Power Tool Division, 618-DC N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Guelph, Ontario.

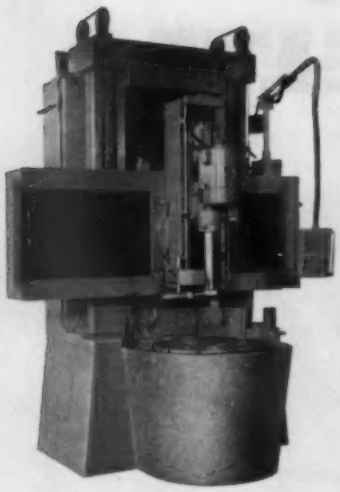
DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

CIRCLE 217 READER SERVICE CARD

Vertical Universal Grinders



model 3-TR
52" swing

Springfield vertical universal grinders are among the most versatile tools you can use for *both* production and toolroom work. Head is easily positioned to grind ODs, IDs, surfaces, offsets and undercuts in *any* combination, generally with one chucking. Work may be regular or irregular in shape, up to 48" high with up to 52" swing on standard machines. Weight of workpiece is no problem because gravity works for you in vertical grinding – helps achieve extreme micro-inch finish and concentricity.

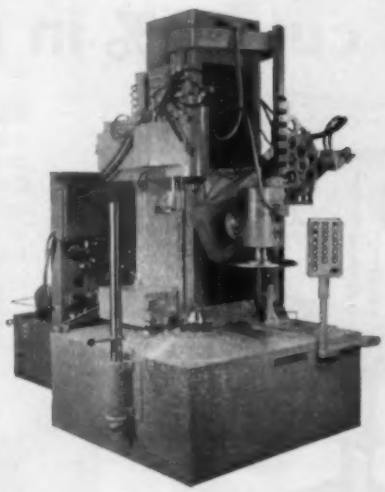
A typical example of a Springfield's remarkable precision is its ability to grind taper valve plugs and seats with one angle setting of the head—and get 95% blue or better on a taper gage with surface finish smoother than 30 RMS.

For high production, sometimes involving automatic loading, cycling, size control and unloading, Springfield builds special vertical grinding machines. Most of these can be reset when part changes occur. Another area in which Springfield has pioneered is in vertical contour grinding machines that handle missile parts.

If you would like to know more about Springfield vertical grinders, please write for Bulletin 197-G.

MMT-PE

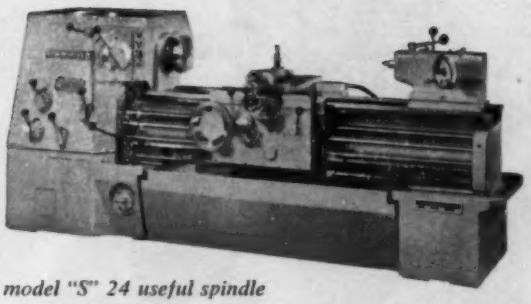
new developments coming!



vertical contour grinder

SPRINGFIELD

The Springfield Machine Tool Company
Springfield, Ohio



model "S" 24 useful spindle speeds, 66 feeds & threads heavy duty 16" medium duty 20"

Engine & Toolroom Lathes

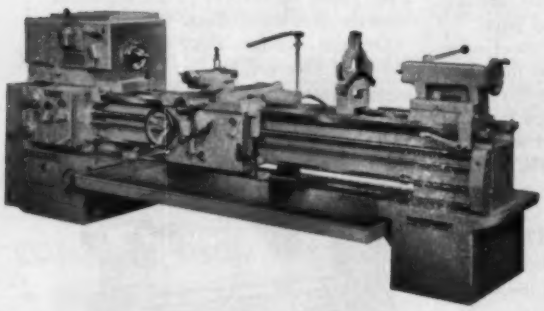
Springfield lathes have 10, 15 or 20 horsepower motors for heavy cuts, and have simple, practical features that keep the operator productive and keep the maintenance man away. Pressurized mist lubricates the headstock. Only four gears are in mesh for a given speed—the others run free. Clean, functional design and simplified controls promote pride of workmanship and minimum waste motion.

Ruggedness with precision has always been characteristic of Springfield lathes—because they are built to *one* standard of excellence. A Springfield engine lathe meets the accuracy standards set up for toolroom lathes —without *any* cost penalty.

Whenever you want maximum power and efficiency, and the cost designed out by designing simplicity in, consider a Springfield lathe. A full range of attachments is available—hydraulic contouring and reproducing, plain and universal relieving, taper, etc.

If you would like to know more about Springfield lathes, please write for Bulletins 190-G and 201-G.

new developments coming!



model 280 16 useful spindle speeds, 60 feeds & threads heavy duty 14", 16" medium duty 20"

The Springfield Machine Tool Company
Springfield, Ohio

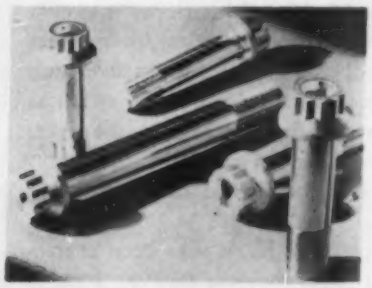
SPRINGFIELD

time make use of gravity feed and discharge in automated production lines.

Basic design is flexible. Variations can be obtained by using a flanged as opposed to a plain slide, giving a larger slide area, or by modifying dimensions such as length of stroke and slide adjustment. Available with either flywheel or geared drive, presses have an arrangement of electrical controls that will give the operator instant command of every function. Line is equipped with Cleveland's electrically controlled air-operated friction clutch.

Cleveland Punch & Shear Works Co, 3917 St Clair Ave, Cleveland 14, Ohio

MORE DATA? Circle 86, inside back cover



High Tensile Strength Retained At 900F with Light Weight Bolt

The 926 series threaded joint is rated at 260,000 psi minimum tensile strength at room temperature and 200,000 psi ultimate strength at 900 F. It is claimed by the manufacturer to be the strongest structural bolting available, hot or cold.

Used in combination, the EWB 926 bolt and FN 926 self-locking nut are designed for applications in aircraft, missiles and other elevated temperature equipment.

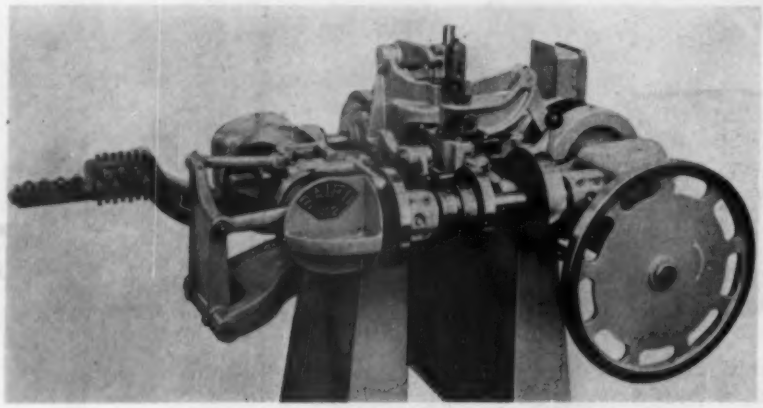
The EWB 12-point external wrenching bolt is made of 5% chrome, high strength steel alloy. Nut material is AMS 6304 steel. Both nut and bolt are finished with diffused nickel cadmium plating to resist corrosion and oxidation at high temperatures. Fatigue strength at 65,000 cycles is 135,000 psi, endurance limit is 110,000 psi at 8,000,000 cycles, and rupture strength for a 100-hr stress is 140,000 psi.

Positive locking to prevent loosening from vibration is achieved by a three point displacement of the locking collar.

Bolts and nuts are produced in diameters sizes #10 through ⅞ in., fine thread series.

Standard Pressed Steel Co, Jenkintown, Pa

MORE DATA? Circle 87, inside back cover



Baird Automatic Four-Slide Forming Machine Does High-Speed Production

Called the No. 2, this horizontal automatic four-slide was designed for high-speed production of parts made from commercial wire stock or ribbon metal. It will accept round, half round, square, or flat metal stock and automatically take coiled wire from a reel, straighten, feed, and cut off the required length. It will then form and eject the produced part.

Where press operations are required, a press attachment is available. Other attachments include: form raising attachment, for 2-stage forming; pinch pointing attachment, for pointing ends of parts; secondary cut-off attachment to give special cuts to end of ribbon metal parts.

The No. 2 will take soft steel wire up to ⅛-in. dia and ribbon metal to 1-in. width. The maximum feed length using four slide stops is 8 in.; where stops are not used, it will provide a feed length up to 9½ in. For regular work the machine will produce 150 parts per min.

The Baird Machine Co, 1700 Stratford Ave, Stratford, Conn

MORE DATA? Circle 88, inside back cover

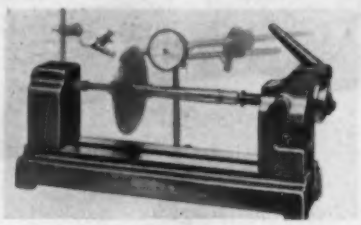
Cage Type Roller Bearings Offered in Two New Series

Bearings, designed for applications requiring maximum radial capacity, have relieved-end rollers to minimize high stress concentrations and fatigue at corners. Rollers are of square end type for maximum effective roller length and are retained in pockets of tubular steel cages to maintain alignment while running.

MC Series is interchangeable dimensionally with standard needle bearings in sizes from ½ to 2-in. shaft diameters, but uses larger diameter and longer rollers for increased load capacity. HS Series is an entirely new series made in inch sizes dimensionally between standard needle bearings and conventional cylindrical roller bearings in a range from 1 to 2-in. shaft diameters. This series is heavier sectioned than the MC.

Orange Roller Bearing Co, 557 Main St, Orange, NJ

MORE DATA? Circle 89, inside back cover



Bench Center Offered For Production Line Inspection

Bench center for production inspection of machined parts, stampings, and assemblies is adjustable from 0 to 10 in. max, has a fixed removable head center, and a locking quick spring travel on the tailstock center. Unit, of Meehanite cast construction, is designed to take all standard indicator rods and attachments.

Quality Gage Co, 968 East 69 Pl, Cleveland, Ohio

MORE DATA? Circle 90, inside back cover

New MODEL 50 equips your lathes to do a lot more for a lot less!

$70.00 for the chuck

$65.00 for the collets

THE WORLD'S MOST MODERN COLLET CHUCK

Designed expressly for ATLAS, CLAUSING, DELTA, LOGAN, SHELDON, and SOUTH BEND LATHES

These and others of similar power and capacity now give top performance when equipped with the new Jacobs Model 50. Improve performance of your lathes. Increase spindle capacity as much as 42%. Get greater accuracy and stronger grip. It's easy and inexpensive with new Model 50 and its companion Rubber-Flex collets.

CONSIDER THESE FEATURES . . .

- **Gripping Power**
  Model 50 is made for heavy duty turning. It has tremendous gripping power.
- **Accuracy**
  Model 50 is factory tested—maximum runout .001" T.I.R. at the nose when properly mounted.
- **Thin Walled and Fragile Work**
  Always parallel Model 50 Rubber-Flex collet jaws permit chucking of tubing and fragile materials without crimping or scoring.
- **Range**
  The 10 Rubber-Flex collets in the 500 Series, developed especially for use with Model 50, cover a greater bar stock range than 63 old-fashioned steel collets. You can chuck any bar between 3/32" and 1-1/16" with this set of 10 collets.
- **Capacity**
  Model 50 eliminates capacity-wasting draw bar. You can increase spindle capacity up to 42%.
- **Adapters**
  Model 50 adapters are fully machined for immediate mounting. Available in all popular threads and American Standard L00 taper.
- **Price**
  Model 50 prices are revolutionary!
  $70.00 for the chuck.
  $65.00 for the complete set of 10 collets.

MODERNIZE YOUR LATHES WITH JACOBS MODEL 50 AND RUBBER-FLEX COLLETS. YOU CAN'T AFFORD NOT TO!

See your Jacobs industrial supply distributor. Give him the opportunity to prove these fantastic facts with a convincing demonstration at your desk! Call him today.

INDUSTRIAL DISTRIBUTOR — A FIRST NAME IN SERVICE

Jacobs CHUCKS

The Jacobs Manufacturing Co., West Hartford 10, Conn.

11-STATION MILLING AND DRILLING MACHINE produces connecting rods and caps. In each rod and cap, two oil holes are drilled and countersunk and one notch is milled. Machine employs eight R-J self-contained hydraulic quill units, each with a two-spindle head, for the drilling operations. Eleven fixtures are mounted on a 48-in. index table; cycle time is 10.5 sec—*Rehnberg-Jacobson Mfg Co, Rockford, Ill*

MORE DATA? Circle 91, inside back cover

Non-Carbide Drill Drills Steels Of Rh 51C and Harder

DoAll has developed a drill for hardened steel that is not carbide yet is capable of drilling steels Rh 51C and harder. It can be resharpened or modified with an aluminum oxide wheel.

Drill anneals the material at the drillpoint area as heavy pressure is applied; it generates intense heat from the pressure exerted, removing a softened chip. Tool itself has a remarkably high red-heat hardness and is not affected by intense heat except for a slight rounding over of the point, which actually helps the heat generation. Generation is local and is confined to a small area adjacent to the hole. These drills are not recommended for use on materials that are naturally hard and cannot be annealed. They can be used successfully on manganese steels and similar work hardening metals. With a minimum of 0.004-in. stock to be removed, drill will operate like a reamer on hardened steel. Size range is from ⅛ through ¾ in. Sets are also available which include sizes 3/16 through ½ in. by 16ths.

DoAll Co, Des Plaines, Ill

MORE DATA? Circle 92, inside back cover

Ultrasonic Materials Tester Does Non-Destructive Inspection

Circosonic Model CM100 is designed for non-destructive inspection of materials which can support ultrasonic waves, such as metals, plastics, ceramics. Uses include: flaw detection, either surface or internal; thickness measurement from one side; and determination of physical and structural properties. The portable unit uses any plant power supply. Accessories for a wide range of applications are available.

Components are a generator and receiver for high frequency vibrations sent in a pulsed beam through material to be inspected; discontinuities, as well as the opposite end, reflect vibrations back to receiver indicating size and location of reflecting areas on the viewing screen.

Circo Ultrasonic Corp, 51 Terminal Ave, Clark, NJ

MORE DATA? Circle 93, inside back cover

Daragraph Tool Steel Contains Carbon in Free Graphite Form

Machining this oil-hardening steel is remarkably easy, because 1/3 of its carbon content is uniformly distributed as free graphite to increase its anti-friction properties. Daragraph is an AISI-SAE Type 06 steel with composition of: C 1.45, Mn .80, Si 1.15, Cr .20, Mo .25, P and S 0.03% max.

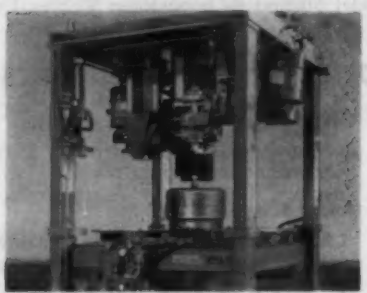
The steel has a high impact value which, according to manufacturer, assures that edges of blanking dies won't spall, chip, or crumble. It also gives long life to piercing and cutting dies that must be used without lubrication.

Heat treating is safe because Daragraph is nondeforming and has a hardening range of 1475-1550 F. Oil quenching gives Rh63-66C; cooling in still air about Rh30-35 C. Tools tempered, for optimum toughness and hardness, at 300-450F have Rh62C.

The material comes as billets or bar stock; forged shapes are available to order.

Darwin & Milner, Inc, 2222 Lakeside Ave, Cleveland 14, Ohio

MORE DATA? Circle 94, inside back cover



AUTOMATIC DEBURRING MACHINE deburrs holes in appliance baskets in preparation for spray finishing. Using four wire brush heads, unit will completely finish a basket in a 10-sec cycle and can be used individually or as part of an automated production line—*Murray-Way Corp, PO Box 180, Birmingham, Mich*

MORE DATA? Circle 95, inside back cover

CIRCLE 221 READER SERVICE CARD ►

Numerical Control Solved These Tough Production Problems

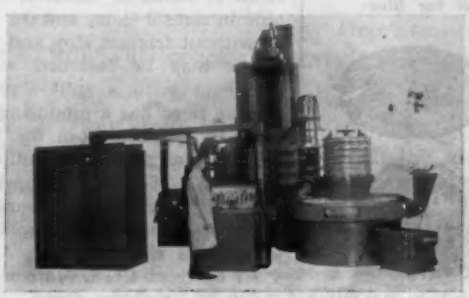
Problem: *Drill and tap ojival, conical, and cylindrical sections for missile components.*

Solution: A BarnesdriL 2-spindle tape-controlled unit with four-motion-control, including a head that tilts to 15° plus or minus off horizontal center. Capable of handling parts to 36″ diameter and 72″ high, this unit gives ±.003″ positioning accuracy with repeatability to ±.0005″. Holes can be spaced

evenly or unevenly. Standard 8-channel tape also controls tool changes, coolant selection, rapid approach and return, sensing, etc. Rotary table indexes 360°.

Problem: *Reduce set-up and machining time on jet engine casings requiring 3 different hole sizes and up to 4 operations per hole.*

Solution: A 4-spindle, 2-motion BarnesdriL numerically controlled unit completes rough drilling, rough facing, finish boring, and generating front and back parallel faces on 248 holes in 4½ hours . . . a 74% savings



in set-up and machining time. Individual spindles are tape-controlled to operate from 3 different feed-out ratios, entirely eliminating tool changes. The machine has the ability to select exact position, hole size, and cutting depth quickly, and with extreme accuracy. Positioning is guaranteed to .003″, depth to .001″, and repeatability to .0002″, making it a highly flexible production machine for cylindrical parts up to 50″ in diameter and 40″ in height.

Problem: *Cut production costs on a variety of boiler plate and bolt circle work.*

Solution: A BarnesdriL numerical control unit cuts production time by 47%. This

is a single-spindle drilling machine with vertical spindle travel and a rotary indexing table with capacity to 50″ diameter and 42″ in height. Operations include combination drilling-countersinking, drilling-counterboring, straight drilling, reaming, counterboring, and countersinking.

Problem: *Informing every cost-conscious metalworking executive of other BarnesdriL advances and advantages in tape control machining.*

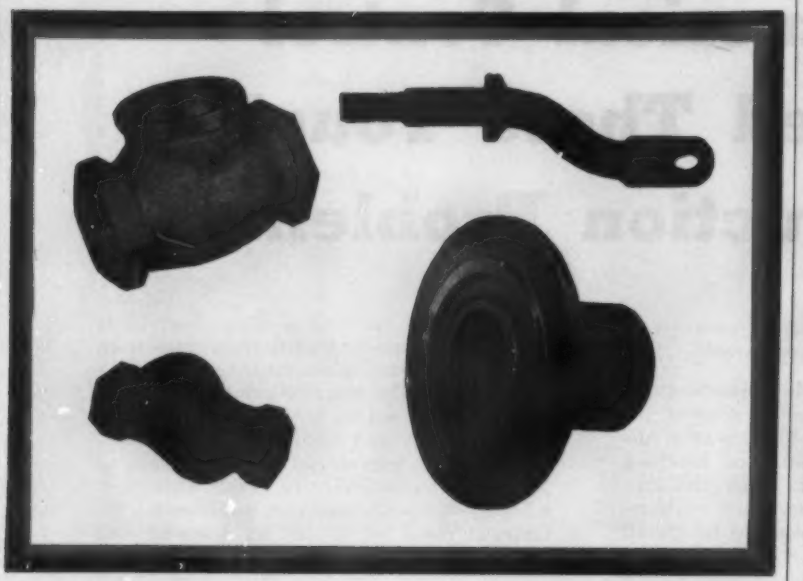
Solution: Write, wire, or call for complete information. We have detailed reports on the above machines.

BARNESDRIL PRODUCTION UNITS

BARNES DRILL CO.

830 Chestnut St., Rockford, Illinois

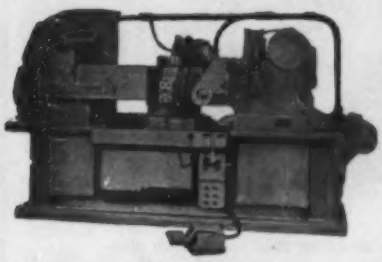
Detroit Office: 13121 Puritan Avenue



PARTS LIKE THESE and MANY OTHERS ARE BEING PRODUCED

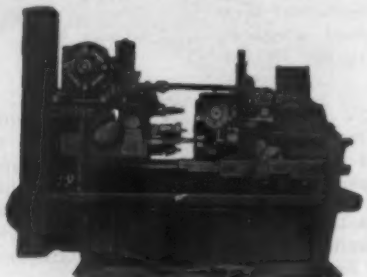
with speed, convenience and economy...

on GOSS & DeLEEUW AUTOMATIC CHUCKERS



4-SPINDLE TOOL ROTATING CHUCKING MACHINES available in three sizes, combine various turning, boring, facing, threading, multiple drilling and tapping operations on a wide range of single-ended parts.

THE "ONE-TWO-THREE" 7 - SPINDLE TOOL ROTATING CHUCKING MACHINE can complete in one operation as many as three ends of valve bodies, plumbing fittings, etc. eliminating secondary operations.



Send samples of your work for time estimates. Ask for illustrated literature.

MMP-PE

GOSS & DeLEEUW

GOSS and DeLEEUW

MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

NEW SHOP EQUIPMENT

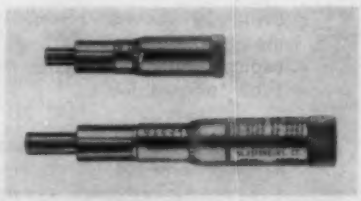
Swinging Arm Press Unloader Attaches to Crown of Press

Air-operated automation unit for removing stampings is electrically controlled by the press. It will operate at speeds up to 40 spm with 45-psi airline pressure. The PAS swinging arm provides a vertical lift for the stamping with a smooth, non-dipping unloading stroke. Operating linkage mechanism eliminates use of cams and oil cylinder cushioning. It is controlled by a heavy-duty small-diameter JIC air cylinder.

PAS low inertia jaw assemblies (standard jaw, vertical flange jaw, chisel jaw, and Vac-Hand) are available to fit three standard models of the arm, designated Series 100 small, 200 medium, and 300 large.

Press Automation Systems Inc, 25418 Ryan Rd, Warren, Mich

MORE DATA? Circle 96, inside back cover



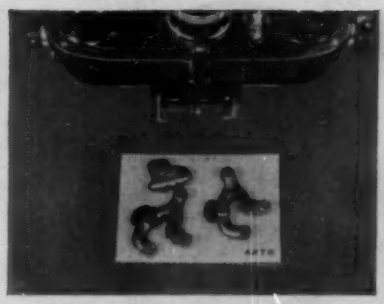
Adaptable Micrometer Heads For Use in Special Machinery

New line of heads that can be attached and utilized in special machinery, tools, or fixtures, is available in sizes 0-½ in. and 0-1 in. with or without friction stop and vernier. Heads may be fastened with soft solder or with a split clamp. The 0-½-in. head has a mounting section 15/32 in. long and ⅜ in. dia. The 0-1-in. head has mounting section ¾ in. long and 7/16 in. dia. Adjusting nut assembly provides full engagement with the spindle thread, making the instrument shockproof.

J T Slocomb Co, 67 Matson Hill Rd, South Glastonbury, Conn

MORE DATA? Circle 97, inside back cover

1) No darkroom loading. Ready for exposure as it comes from the box.



2) Just place in position and expose —the film is protected from dust, dirt, light and moisture.

3) In the darkroom, pull the rip strip, remove film, and process.

...NEW!... READY PACK ....

Kodak Industrial X-ray Film

- Sealed tight until processed—keeps clean
- Very convenient to handle—saves time
- Readily available in Type AA and Type M

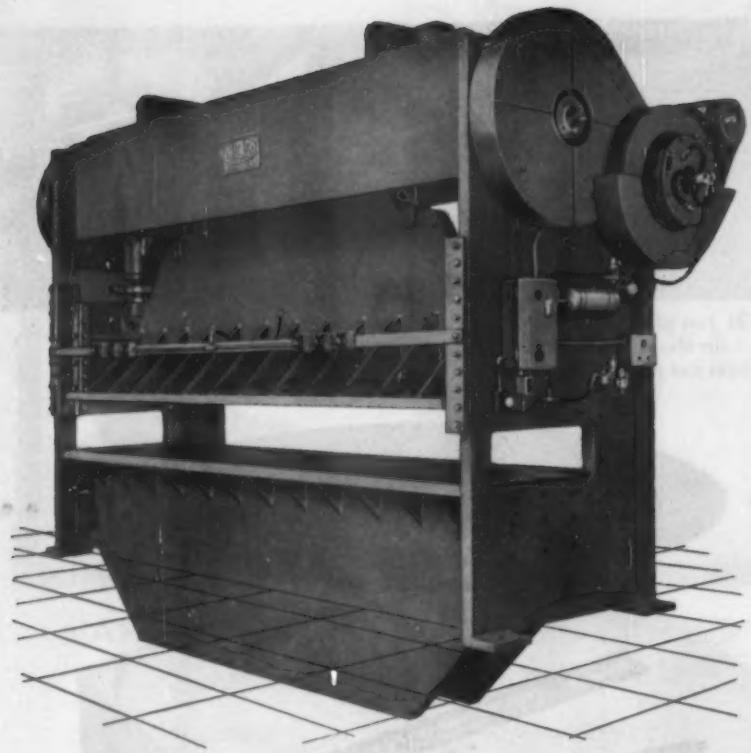
Here's new convenience when you are inspecting aluminum or magnesium alloys, thin steels, plastic or anything where lead screens are not required.

Kodak Industrial X-ray Film, Type AA and Type M-Ready Pack comes to you with each sheet sealed in a light-tight envelope ready for exposure. A convenient rip strip makes it easy to open in the darkroom.

These films come 75 to a box in sizes 8 x 10, 10 x 12, 11 x 14, 14 x 17. Order them from your Kodak X-ray dealer.

EASTMAN KODAK COMPANY
X-ray Division • Rochester 4, N. Y.

Kodak TRADE MARK



CHICAGO DREIS & KRUMP

PRESSES
STRAIGHT-SIDE TYPE

large die area
capacities up to 400 tons

This is a typical model of CHICAGO straight-side-type presses used for multiple punching, notching, and trimming operations. This press with a die area of 48 inches by 198 inches has a capacity of 200 tons.

Complete recommendations for any job on request.

6674

CHICAGO DREIS & KRUMP

Press Brakes • Straight-Side-Type Presses • Press Brake Dies
Hand and Power Bending Brakes • Special Metal-Forming Machines

DREIS & KRUMP MANUFACTURING CO.
7434 South Loomis Boulevard, Chicago 36, Illinois

NEW SHOP EQUIPMENT

Thixotrophic plastic putty, which cures at room temperatures into a solid chunk of epoxy resin, is being widely used to trim the edges of light-weight sandwich structures. The new plastic, Narmco 3150, provides a rigid, structurally strong edge for fastening the sandwich. When cured at room temperature, the material has a Barcol hardness of 53-60, and may be drilled, tapped, or sanded without signs of cracking or chipping—*Narmco Resins & Coatings, 600 Victoria, Costa Mesa, Cal*

MORE DATA? Circle 98, inside back cover

New design high strength bolt, with larger head and shorter thread length, is said to give substantial increase in the advantage of high strength bolts over other types of structural fasteners. Approved by Research Council of Riveted and Bolted Structural Joints and the American Institute of Steel Construction, the new design bolt can be stressed to 85,000 psi or more without a washer—*Russell, Burdsall & Wa d Bolt and Nut Co, 100 Midland Ave, Port Chester, N Y*

MORE DATA? Circle 99, inside back cover

Super high speed steel blade is said to cut all types of ferrous metals and is guaranteed by manufacturer to perform up to three times better than any standard blade. Designed for production cut-off work, it was developed by new methods and costs only slightly more than regular blades. Blade is furnished welded-to-length, individually packaged in all standard widths, thicknesses, and toothing—*Simonds Saw & Steel Co, Fitchburg, Mass*

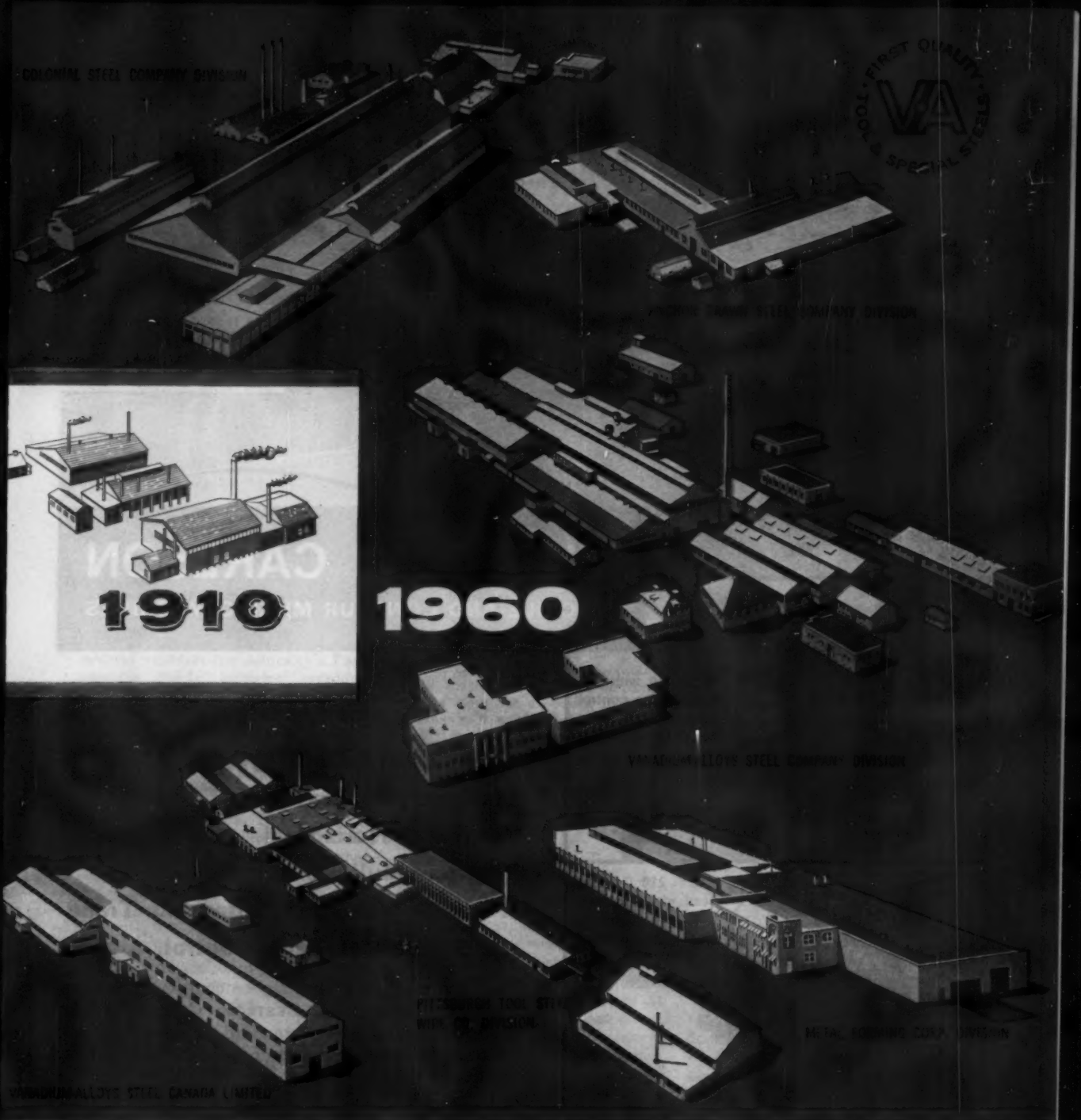
MORE DATA? Circle 100, inside back cover

Aluminum casting alloy, Adaptaloy, is especially suitable for castings which require cold forming or bending during assembly. Its high fluidity, good weldability, and clear white color when anodized have made it a favored material for art castings—*American Smelting and Refining Co, 120 B'way, N Y 5, N Y*

MORE DATA? Circle 101, inside back cover

Machinists chest, Model 526, is wide enough to accommodate a 24-in. scale, ¼-in. drill, and other extra long tools. With a top till plus seven drawers, all felt-lined, the 526 is designed for use as a separate bench chest, or in combination with base-type companion tool box MC28—*Kennedy Mfg Co, 200 Harrison St, Van Wert, Ohio*

MORE DATA? Circle 102, inside back cover



For fifty years

first quality in tool and special steels

Our first half century has seen us grow from a small plant with crucible-and-hammer production facilities to one of the largest specialized makers of fine tool and special steels . . . a leader in research and development, and equipped with the most modern steelmaking instruments of production.

We are tied to the past with but a single link—unvarying quality of product. The steels we made in the beginning were the best of their times, and Vanadium-Alloys' steels lead in quality today. Continued advance in performance is our pledge to industry for tomorrow. *Let us work with you on your most demanding assignments.*

VANADIUM-ALLOYS STEEL COMPANY

GENERAL OFFICES: LATROBE, PA.

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co. • Vanadium-Alloys Steel Co.

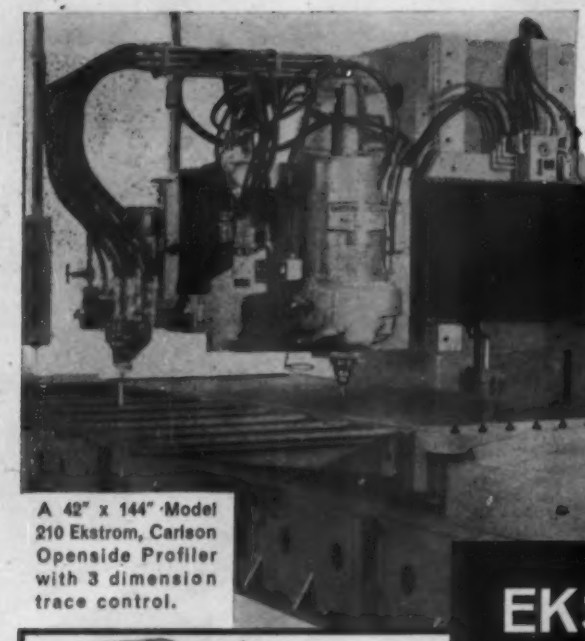
SUBSIDIARIES: Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)

CIRCLE 224 READER SERVICE CARD

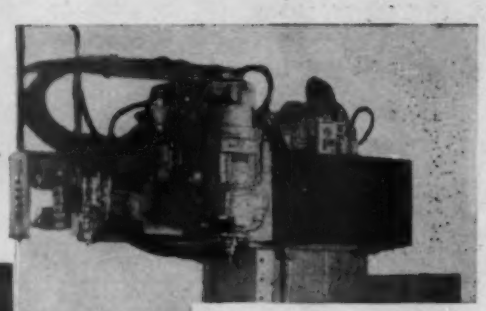
SPACE 846

MMT-PE

MACHINE TOOL EXPOSITION



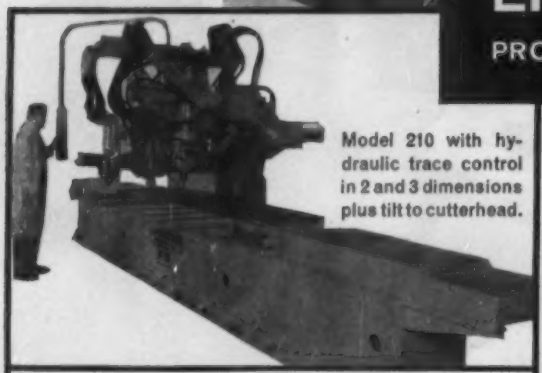
A 42" x 144" Model 210 Ekstrom, Carlson Openside Profiler with 3 dimension trace control.



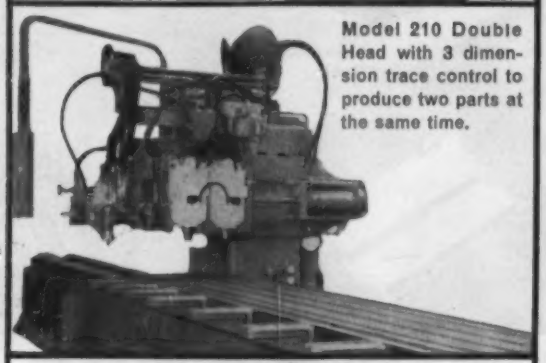
The repositionable crossrail makes possible increased work height capacity shown here.

EKSTROM, CARLSON

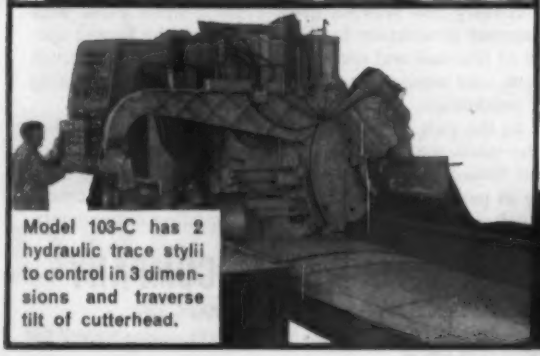
PROFILE AND CONTOUR MILLING MACHINES



Model 210 with hydraulic trace control in 2 and 3 dimensions plus tilt to cutterhead.



Model 210 Double Head with 3 dimension trace control to produce two parts at the same time.



Model 103-C has 2 hydraulic trace stylii to control in 3 dimensions and traverse tilt of cutterhead.

. . . . from small to large

Openside or Bridge Type
Stationary or Traveling Table
Vertical or Horizontal
Single or Multiple Spindles
. . . . with Manual or Automatic Trace and Numerical Tape Control, too!

Yes, whatever your profiling or contouring requirements are there is an EKSTROM, CARLSON Profile Milling Machine (either standard or tailored to suit your special need) that will do your job with utmost efficiency.

Shown here are only a few of our Openside Model 210 Machines and the Model 103-C Traveling Column Horizontal Spindle Machines.

WHY NOT ask for a representative to call and tell you the whole story on these and other EKSTROM, CARLSON high quality Profile Milling Machines.

EKSTROM, CARLSON & CO.
1414 RAILROAD AVE. ROCKFORD, ILL.

FIELD REPORT...

Japanese Company Buys US Sewing Machine Firm

Japan's largest sewing machine manufacturer, Janome Sewing Machine Co Ltd, has purchased a leading American company and will start distributing Japanese machines in the US. Janome has purchased the New Home Sewing Machine Co, Los Angeles subsidiary of Free Sewing Machine Co. As part of the agreement, Free Sewing will cease to do business. Japanese organization says that it hopes to capture 20% to 25% of the US market.

Ingalls Ship Contract

Ingalls Shipbuilding Corp, Birmingham, Ala, and Pascagoula, Miss, is the apparent low bidder, at $62.6 million, on a contract for six new merchant ships, according to the Maritime Administration. Order would give employment to an additional 1000 workers over a period of several years at the company's Pascagoula Yards, bringing employment there to 5800 during peak construction. Ships are to be built for Farrell Lines for service between the US and South and East Africa.

$7 Million Order to Bell

Bell Helicopter Corp, Dallas, has a $7 million contract from air Materiel Command for development of the turbine-powered HU-1D helicopter. Order calls for production of an undisclosed number of the craft. The HU-1D is an enlarged fuselage version of Bell's HU-1B, also a turbine-powered vehicle. New model will carry 12 fully equipped soldiers, 50% more than the B model.

Miami Steel Plants

Two steel plants, both electric furnaced, are scheduled for Miami. The first, with a proposed 75,000 to 90,000 net ton annual production of reinforcing bars and merchant shapes, is expected to go into production next April. The second will have a yearly capacity of 48,000 tons of reinforcing bars and structural steel.

Case-hardened rock-drill components are moved from gas carburizer furnace to an electrically operated cooler (foreground) at Holman Brothers Ltd, Camborne, England. Company, largest manufacturer of compressed air equipment in the Commonwealth, makes drills, pumps, air compressors, and pneumatic tools used in a wide range of industries, especially in mining and civil engineering. Many of the components require specialized heat treatment, depending on work they're designed for

American-Standard Initiates "Total" Leasing Plan

American - Standard's new leasing plan covering its complete line of air conditioning, industrial, and power equipment products is described as "total" because it includes all types of non-expendable equipment in the full range of sizes produced by the company's Industrial Division, whether the purchased goods be standard off-the-shelf items or a complete custom installation. Division makes industrial air conditioning and air handling equipment, air pollution control equipment, fluid drives, heat transfer products, surface condensers, steel boilers, and related industrial products. The leasing plan retains for the purchaser all of the advantages of an outright purchase, and an option to buy is a standard element of the contract.

White Sewing Machine Diversifies

In another step in expansion plans for its Industrial Supply Division, White Sewing Machine Corp, Cleveland, has acquired Murray W Sales Inc of Detroit from the Ogden Corp of New York. Company, a wholly owned subsidiary of Ogden, is one of Michigan's oldest and largest wholesalers of plumbing and heating equipment, and industrial pipe, valves, and fittings. It operates

McGIRK'S WORKS

by GEO. CRENSHAW

COLLECTION FOR DRILLER. REMEMBER? HE JUST GOT MARRIED!
T'ANKS, JIGGERS!
CLUNK!
HEY, WAIT A MINUTE! DIDN'T WE JUST DONATE TO HIM LAST WEEK?
YUP, BUT THIS WEEK HIS MOTHER-IN-LAW MOVED IN!
MOE'S CORNER
I'm collecting for a GOING AWAY GIFT...
...for me.. I got FIRED.

Highly polished flutes produce smoother, more accurate holes!

It pays to specify

ACE

DRILLS
REAMERS
BLANKS

Premium Quality High Speed Steel, Carbide Tipped and Solid Carbide.

DRILL SETS

Fractional, Wire and Letter size drill sets packed in convenient folding index cases.

BLANK SETS

Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits.

Call your local distributor today—or write Ace direct for latest catalog and price information.

ACE DRILL
Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

Field Report . . .

branches in Flint, Pontiac, and Wyandotte, as well as three outlets in the metropolitan Detroit area. The 84-year-old White started its diversification program three years ago and now consists of four basic divisions: Industrial Supply; Home Equipment; Apex Reinforced Plastics; and Strong Steam Specialties.

Big Missile Order to Raytheon

Raytheon Co, Waltham, Mass, has received contracts totaling $56.7 million for continued work on the Army Hawk ground-to-air missile. Company is prime contractor on the Hawk project. Orders cover engineering services, production of ground support equipment, and manufacture of factory and system test equipment.

Ryan Gets Navy Work

Ryan Aeronautical Co, Los Angeles, has a $17.3 million follow-on contract from the Navy's Bureau of Weapons for an undisclosed number of airborne electronic navigation systems. Deliveries will begin next February. Company received a $34 million Navy contract on June 22 for the same type of equipment.

Foote Mineral to Build in Tenn

A $6 million electrolytic manganese plant with annual production capacity of 20 million pounds will be built at New Johnsonville by Foote Mineral Co of Philadelphia. First stage of construction is expected to be completed by Jan 1962. Operations will begin with an initial payroll of about $1 million for 160 employees.

General Transistor Merging Into General Instrument Corp

Formal merger agreement has been signed between General Instrument Corp and General Transistor Corp; stockholders will vote on the proposal Aug 30. GI manufactures electronic components and equipment and produces semiconductor devices. GT makes transistors and other electronic and semiconductor components for use in electronic computers.

Lamson Acquires Canadian Firm

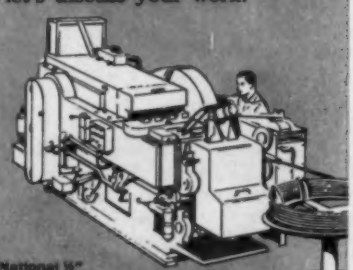
James A McKechnie Ltd, Toronto manufacturer of conveyors, has been acquired as a subsidiary by Lamson Corp, Syracuse, NY, maker of pneumatic airtube systems, automatic pallet loaders, commercial and indus-

still more parts from wire!

These important parts are cold-formed from coiled wire, start to finish in compact, efficient National Cold Headers.

These parts are formed practically scrapless. All achieve remarkable savings over past methods.

If you make odd-shaped parts, may we help you evaluate them for cold-forming from wire? Better yet, come to Tiffin, witness our demonstrations and let's discuss your work.



National ½" Five-Station Progressive Cold Header

NATIONAL MACHINERY CO.
TIFFIN, OHIO, U.S.A.
HARTFORD DETROIT CHICAGO

CIRCLE 227 READER SERVICE CARD

CIRCLE 228 READER SERVICE CARD

trial conveyors and blowers. Lamson will expand the McKechnie operation in Canada in order to offer a full line of Lamson package conveyors and related equipment to Canadian industry and commerce.

Trane Expanding in South

Trane Co, La Crosse, Wis, will build a 120,000 sq-ft addition to its Clarksville, Tenn, plant, an increase of about 80%. Production capacity for manufacture of residential and commercial heating and air conditioning units will be doubled. New construction and machinery will mean an investment of $1.2 million.

Yuba Buys Furnace Firm

K W Anderson Co, Tulsa, Okla, manufacturer of high temperature furnaces, has been purchased by Yuba Consolidated Industries of San Francisco. Company will be consolidated with the Petro-Chem Development Division of Yuba because products and markets are compatible. Petro-Chem for the present will maintain design, engineering, and manufacturing activities in both its Houston, Texas, plant and the Anderson facility in Tulsa.

Siegler Gets Atlas Work

Initial contract for approximately $15 million has been received by Siegler Corp from Convair-Aeronautics Division of General Dynamics Corp of San Diego for automatic electronic launch control equipment for the Atlas. Order provides for production over a two-year period. The Hallamore and Hufford divisions will complete the design and produce the units which will control the preparation and launching of the missile from underground silos.

"Maybe your father did it this way, but it's later than you think."

GEMCO

SHAPERS SAVE DOLLARS in your Machine Shop

Facts in Brief . . .

1. Powerful, rigid, efficient, dependable modern machines.
2. Tested to highest military accuracy specifications.
3. Ample safety devices, guards, convenient controls.
4. Pressure lubrication, automatic "Lubrigard" safety device.
5. Maximum range of ram speeds, table feeds.
6. Combined horizontal and vertical rapid traverses.
7. Double bull gear drives, automatically selected.
8. Smooth cutting tool action at all times.
9. Shockless clutch-brake sensitive lever control.
10. Guaranteed performance, prompt service, attractive prices.

Sizes 16" to 36" stroke in either Production or Universal Type.

GEMCO

SHAPER COMPANY
4644 Gravois Ave.
St. Louis 16, Mo.

Founded in 1917

NEW
PART UNLOADERS REDUCE HANDLING

For fast, positive and lower-cost blank removal, use Lahr reciprocating chute unloaders actuated by your press stroke. Can be cable-timed (air power on out stroke) or rack-driven through full cycle. Simple mounting plus versatility of unloading to bins and conveyors. Variable stroke with gear change. Write for Brochure and Prices.

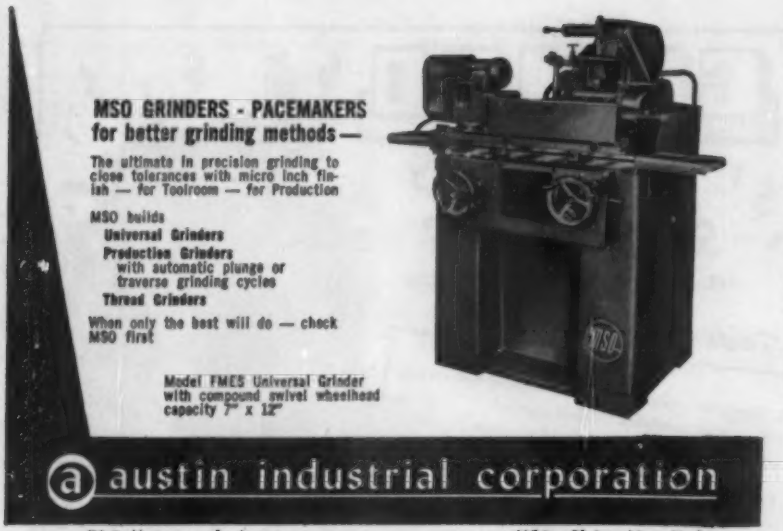
Model 20-59 shown

STANDARD MODELS AVAILABLE

Model No.	Tray Width	Tray Stroke	Power In	Power Out
20-RR-59	10" to 36"	10" to 20"	Rack	Rack
20-CT-59	10" to 36"	10" to 30"	Cable	AirCycle
30-RR-59	10" to 72"	12" to 30"	Rack	Rack
30-CT-59	10" to 72"	12" to 30"	Cable	AirCycle

Special tray widths and strokes available

Lahr MACHINE & TOOL CORP.
3606 MAPLEWOOD AVE. — TOLEDO 10, OHIO


MSO GRINDERS - PACEMAKERS
for better grinding methods—
The ultimate in precision grinding to close tolerances with micro inch finish — for Toolroom — for Production
MSO builds
Universal Grinders
Production Grinders
with automatic plunge or traverse grinding cycles
Thread Grinders
When only the best will do — check MSO first
Model FMCS Universal Grinder with compound swivel wheelhead capacity 7" x 12"
austin industrial corporation
76-F Mamaroneck Avenue
White Plains, New York

CIRCLE 230 READER SERVICE CARD

JIG
BORING
MACHINE
WITH LEITZ OPTICS
Table size — 33½" x 18½"
Spindle speeds — 63 — 2000 RPM
Boring depth — 12"
Net Weight — 7500 lbs.
The ULTIMATE in
precision
Setting accuracy .00002". Positioning accuracy .00012".
speed
Select any point as starting point. "Zero-in" scales by push button. Read scales to millionths without leaving operator's position.
ease
Direct reading on magnified screens in any quadrant from zero point. Table moves on double roller guides.
When only the best will do — check MSO first.
austin industrial corporation
76-F Mamaroneck Avenue
White Plains, New York

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

TOOLS AND ACCESSORIES

1 AUTOMATIC COUNTING DEVICE —*Pneumaticount, 3400 NE 54th Ave, Portland, Ore.* 4-page illustrated brochure describes device that insures accurate count on any type of equipment controlled by pneumatic or hydraulic action. Counter screws into the line controlling air cylinder and can be installed in five minutes. Models are available for from 1 to 5000 lb and up to 300 counts per minute.

2 WHEEL DRESSERS—*L Newman, 1091 24th St, Oakland 7, Calif.* Catalog presenting data on tangential angle wheel dressers and parts covers surface grinder dressers for use with or without magnetic chuck; hand-type dressers in both light and heavy duty; rotary-type grinder dressers in both standard and special; complete range of dressers for tool and cutter grinders and cylindrical grinders; all replacement parts. Explains the tangential angle and its origin, discusses advantages.

3 CUTTERS—*Cleveland Twist Drill Co, PO Box 6656, Cleveland 1, Ohio.* 64-page illustrated book gives information on the expanded line of Cleveland end mills and the new Cleveland milling cutters. Latter includes plain, side, half-side, concave, convex, corner-rounding, Woodruff key sent, angle and screw slotting cutters, and metal slitting saws.

4 MIST COOLANT EQUIPMENT—*Bijur Lubricating Corp, Rockelle Park, NJ.* 6-page booklet "Spraymist Bulletin" explains application methods for a variety of standard machining operations. These include end milling, face slab and side milling, tapping, tool and cutter grinding, surface grinding, boring-rotating and stationary tool, turning, drilling-reaming, internal grinding and sawing. Uses for Spraymist other than applying water base coolants to metal cutting are also listed. Installation procedures and operating instructions for the Spraymist unit are covered.

5 DIE-SET BALL BUSHINGS — *Thomson Industries Inc, Manhasset, NY.* Illustrated bulletin 111 describes newly developed ball bushing that is interchangeable with sleeve-type bushings in existing dies without modification of the punch holder. Specifications and mounting data included.

6 ULTRASONIC FLAW DETECTOR —*Branson Instruments Inc, 40 Brown House Rd, Stamford, Conn.* 8-page illustrated bulletin T200 covers operation, techniques, and gives complete list of spe-

"Tell me again how adventuresome and exciting this work is—I keep forgetting."

NOW! Microstoning Provides Controlled/Micro-Inch Surface Finishing In Minutes!

The Taft-Peirce/Supfina Microstoning System has given Metalworking a whole new technique for producing truly superior surface finishes at low cost.

The key is the Supfina Attachments. They can generate a controlled micro-inch finish of whatever degree desired, all the way to a 0.5 micro-inch mirror finish, plus geometric correction . . . in a matter of minutes!

This Microstoning process presents a large abrasive contact surface to the work at low constant pressure, oscillating at up to 3000 strokes per minute, for gentle removal of surface imperfections without heat generation. The job is done quickly, with a surface speed of 20 to 130 ft/minute for roughing and 400 ft/minute for finishing, using one or more stones of required grit that require no dressing.

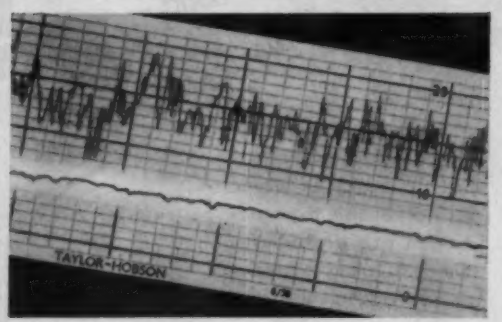
Taft-Peirce/Supfina is versatile, too. The Attachments can be easily mounted on tool posts of lathes, boring mills, planers or on heads of cylindrical grinders.

Microstoning offers so many quality improvement and cost saving opportunities that you should get complete details at once. Demonstrations on your parts can be arranged at the Taft-Peirce Finishing Laboratory. The demand is high so please send your request in early. Call or write for complete information, now.

MICROSTONING MEETS SPECIFIED MICRO-INCH FINISH IN ONE PASS

The part being microstoned above, averaged 16 micro-inch finish as ground, was microstoned in one pass to a specified 7 micro-inch finish in 30 seconds. A single 500 grit microstone on a Taft-Peirce/Supfina Microstoning Attachment did the job.

This Talysurf chart shows surface finish of a guide pin before and after Microstoning. The "before" ground surface reading (above) of 20 micro-inches was changed to a surface reading of 1.5 micro-inches by Microstoning for only one minute! (Chart courtesy of Engis Equipment Co.)



Finish it with TAFT-PEIRCE SUPFINA

TAFT-PEIRCE MANUFACTURING CO., 13 MECHANIC AVENUE, WOONSOCKET 1, RHODE ISLAND

16 press operations performed every second

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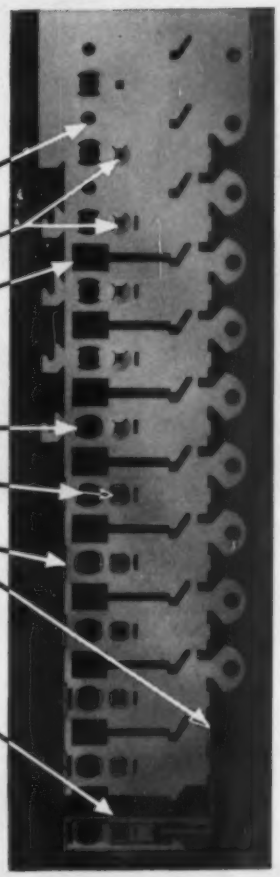
12 STATION PROGRESSIVE DIE!

And, the precision and uniformity demanded by one of the nation's quality hardware manufacturers had to be maintained in each of the millions of DOOR LOCK CASES to be produced.



Whenever ingenuity of die design, extreme uniformity and accuracy of piece parts or reliable mass production are problems—rely on B. Jahn progressive dies to add quality and profit to your product.

Send for B. Jahn "Case History" Brochure — no obligation of course.

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LOCK CASE
.040 cold rolled steel
80 pieces per minute

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

cifications for the portable Sonoray 5, a pulse-echo instrument reported to have exceptional low-frequency resolving power and penetration. By sending short pulses of acoustic energy at ultrasonic frequencies into the object under test, the flaw detector can examine the interior of metals, glass, and plastics from one side only and without physical damage.

7 EXTREME PRESSURE LUBRICANT—*Sun Oil Co, Industrial Products Dept, 1608 Walnut St, Philadelphia 3, Pa.* Technical bulletin provides data on new semifluid Prestige 740A-EP designed to reduce leakage in old enclosed gear cases. Product can be used in small-line centralized lubrication systems where stiff greases are unsuitable. Characteristics and uses are discussed.

8 THERMOCOUPLE COMPONENTS —*Minneapolis-Honeywell Regulator Co, Wayne & Windrim Avenues, Philadelphia 44, Pa.* 28-page catalog C 100-3 contains specifications and ordering information on replaceable components for Honeywell thermocouple assemblies. Components covered are bare elements, elements with insulators, insulators, metal and ceramic protecting tubes, heads, blocks, connectors, and miscellaneous fittings.

HEAT TREATING AND WELDING

9 STAINLESS STRIP FURNACE — *General Electric Co, Schenectady 5, NY.* 4-page illustrated bulletin GED-4124 lists features and advantages of GE High Production vertical furnace for continuous bright annealing of stainless steel strip. Describes unit's heating and cooling sections and threading device, heating units, coolers and blowers. Typical sizes and ratings and a schematic drawing of a typical bright anneal system included.

10 MUFFLES AND HEARTHS—*Rolock Inc, Fairfield, Conn.* 8-page catalog section No. 10 illustrates and describes principal designs of muffles and hearths for horizontal types of furnaces. Typical units pictured with application details.

11 TRANSFORMERS FOR RESISTANCE WELDERS—*Taylor-Winfield Corp, 1048 Mahoning Ave, Warren, Ohio.* 8-page bulletin 9-013 contains illustrated description of primary coil winding and insulation, prepared secondary coil, transformer dipping, and several types of completed transformers. Non-technical discussion covers characteristics and rating, manufacture and test.

12 ARC WELDING ELECTRODES — *Hobart Brothers Co, Troy, Ohio.* Pocket-size card covers eight factors to consider in selecting; gives application information on all mild steel arc welding electrodes and explains how to identify them according to American Welding Society—American Society for Testing Metals classification.

13 PASTE SOLDER MATERIALS — *Fuston Engineering, 17921 Rosedand Ave, Cleveland 12, Ohio.* E-Series bulletin describes new line of electrical and electronic paste solder materials—stable combinations of special fluxes, binders, and solders. Each of the four basic types of pastes can be combined with standard or special solder alloys to meet any soldering condition or specification.

14 PLASTIC WELDING KIT—*American Agile Corp, PO Box 168, Bedford, Ohio.* 2-page data sheet describes kit designed for field or in-plant maintenance or production welding of any thermoplastic fabrication. Kit comes complete with tools, supplies, and operating instructions.

PLANT SERVICE EQUIPMENT

15 LIFT TRUCKS — *Allis-Chalmers Manufacturing Co, Engine-Material Handling Division, Milwaukee 1, Wis.* 8-page catalog BU-640 covers new F Series. Design, engineering, construction, and operating features illustrated and described. Includes information on new Power-Crater engine which powers the three new units. Three 2-page specification sheets cover the three models in the series: BU-641 on the 3000-lb F-30; BU-642 on the 4000-lb F-40; and BU-643 on the 5000-lb F-50.

16 POWER MEGAPHONE — *Wm A Holmin Corp, 1212 Eleventh St, Rockford, Ill.* 4-page illustrated brochure describes the transistorized Voice Gun. Covers material used in the horn, handle, and mouthpiece of the power megaphone, said to be virtually unbreakable. Data provided on the transistor amplifier and power supply. Specifications listed for the 3¼-lb device.

17 STRAPPING TOOLS—*Signode Steel Strapping Co, 2600 N Western Ave, Chicago 47, Ill.* 4-page folder's specification chart lists typical applications for each of four electric powered tools and eight air-powered models: maximum strap tension and weight for each; and strap width and seal size to be used in the various tools. Details appropriate tool mounts, balancers, balance arms, and suspension brackets, and shows typical situations where the tools might be used.

18 TABULATING CARD FILES AND SUPPLIES—*Remington Rand Division, Sperry Rand Corp, 315 Park Ave South, New York 10, NY.* 12-page brochure LBV 814 describes files for storage of tabulating cards and magnetic tapes, available in wide variety of sizes and models. In addition to vertical files, booklet illustrates and describes mechanized filing equipment, and insulated units that protect against fire. Several types of magnetic tape storage units pictured include horizontal housing with individual bins which swing outward; two types of magnetic tape truck; and divider-type shelving.

19 REFRIGERATED TUMBLING BARRELS—*Tumb-L-Matic Inc, St Mary's St, Stamford, Conn.* Illustrated catalog sheet LT-60 describes line of CO_2 barrels for deflashing soft rubber parts without dry ice. Gives specifications on standard machines plus information on optional features. Includes data on cost reductions in handling and storage obtainable through elimination of dry ice method.

20 AIRFOIL BLADED FANS—*American-Standard Industrial Division, Detroit 32, Mich.* 60-page bulletin A-1103 describes new Series 116 centrifugal type units and lists suggested applications. Construction for Class I, Class II, and Class III described and illustrated. 30 pages of capacity tables for standard air conditions are given covering the full line of 15 sizes in both single-inlet and double-inlet construction. Tables list values for each size with static pressures from ¼ to 11½-in. water gage. Outline-type installation drawings are provided to convey basic dimensional data for all sizes and arrangements.

"What took so long?"

Proudly Serving

AMERICA'S LEADING MANUFACTURERS

for over 40 years

WYCKOFF

COLD FINISHED STEEL BARS

Over the years, Wyckoff production facilities have kept pace with the most exacting requirements of all specifications involving: optimum machining properties . . . accuracy . . . outstanding finish . . . controlled physical properties through diversified furnace treatments. For the finest in cold finished steels—SAVE—specify WYCKOFF.

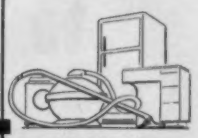
WYCKOFF STEEL COMPANY

GENERAL OFFICES: Gateway Center, Pittsburgh 30, Pa.

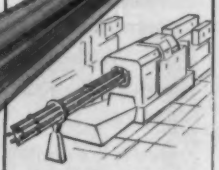
Branch Offices in Principal Cities

Works: Ambridge, Pa., Chicago, Ill., Newark, N. J., Putnam, Conn.

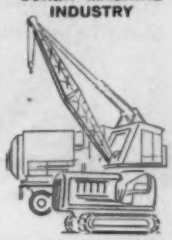
SERVICE CENTERS



APPLIANCES



SCREW MACHINE INDUSTRY



CONSTRUCTION

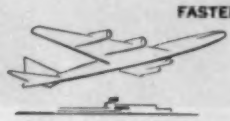
AUTOMOTIVE

RAILROADS

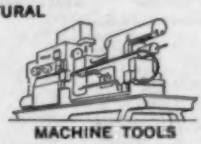
FASTENERS

AGRICULTURAL

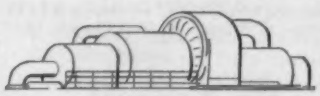
ORDNANCE



AIRCRAFT



MACHINE TOOLS



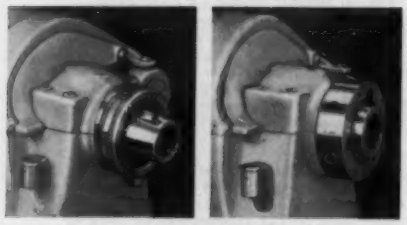
ELECTRICAL

ACCURACY
to keep machining economical

SOUTH BEND 14½" LATHES

Tolerances don't dictate slow-ups when you are using these precision lathes. Their accuracy, smoothness and operating ease save time as well as material on the tough jobs. With proper tooling, work can often be machined with such precision and smoothness that subsequent grinding, honing or lapping operations may be eliminated. Dollar-for-dollar you get more in South Bend Lathes. Write for catalog now and find out how South Bend Lathes can lower your machining costs.

OPTIONAL FEATURES



Cam Lock or Long Taper Key Drive Spindles to provide greater interchangeability of chucks, collets and fixtures.

Hardened—Ground Bed Ways to resist wear and scoring under severe conditions.

SPECIFICATIONS

SWING: 14⅛" over bed and saddle wings.

DISTANCES BETWEEN CENTERS: 24" to 60".

COLLET CAPACITY: 1 1/16".

SPINDLE SPEEDS: 6, 8, 12 or 16. 3-step cone pulley optional at no extra charge.

FEEDS: 48 each—longitudinal, cross and thread cutting.

BASE PRICE: $2178 f.o.b. factory.

South Bend Lathe, South Bend 22, Indiana

Send literature on ☐ 14½" Lathes, ☐ 9" to 16-24" Lathes, ☐ Turret Lathes, ☐ Milling Machines, ☐ Shapers, ☐ Drill Presses, ☐ Pedestal Grinders.

NAME.....

STREET.....

CITY..... STATE.....

SOUTH BEND LATHE

Up to 36 months to pay.

SOUTH BEND 22, INDIANA • *Building Better Tools Since 1906*

Gleason Works, Rochester, NY, has announced that Vice President **Raymond W Doell** (left) will assume overall administration of engineering activities as engineering manager of the firm. **Ralph F Murphy** (center) has been appointed production manager. **Robert F Pigage** (upper right) has been named chief engineer of the newly organized Basic Engineering Research Section, and **John Somerset** (lower right) has been named sales manager for the company

NAMES IN THE NEWS...

Black & Decker Manufacturing Co, Towson, Md, has elected **Alonzo G Decker Jr** president to succeed **Robert D Black.** Mr Black will continue as chairman of the board and of the executive committee, and will function as chief executive officer of the company. Named to succeed Mr Decker as executive vice president is **W Griffin Morrel,** vice president of the Chesapeake & Potomac Telephone Co of Maryland, and a director of Black & Decker since 1957.

Allis-Chalmers Manufacturing Co, Milwaukee, has appointed **G A Saar** general manager, mechanical departments, and **W M Terry Jr** general manager, electrical departments. Mr Saar has been assistant general manager of the Industrial Equipment Division, and Mr Terry director of engineering coordination for the Industries Group. **Louis B Schultz** has been named engine product manager, Engine-Material Handling Division. He was previously OEM engine sales manager for the company's Chicago branch.

Norwalk Powdered Metals Inc, Norwalk, Conn, has appointed **Roy S Jamison** vice president. He was formerly associated with Hoeganaes Sponge Iron Corp, Riverton, NJ, as sales engineering manager.

R K LeBlond Machine Tool Co, Cincinnati, has appointed **R G Schneider** manager of engine lathe sales. He was formerly field sales and engineering manager for the J H Elliott Co, Washington, DC, sales and service representative of leading machine tool builders in Washington, the Virginias, Carolina, and Maryland

Cleveland Crane & Engineering Co, Wickliffe, Ohio, has elected **Herbert T Florence** president and general manager. Formerly executive vice president, he succeeds **Charles F Safreed,** named chairman of the board. **William J Ryan** has been named vice president and assistant general manager

Barden Co, Danbury, Conn, has appointed **Perry R Roehm** vice president. Mr Roehm, who was formerly vice president, sales, of Barden, left in 1955 to become vice president and later president of Norden-Ketay Corp.

General Drop Forge Corp, Buffalo, has appointed **Joseph E Starich** general manager. Formerly general superintendent, he succeeds **John J Morrissey** who has been named general manager of **Dana Corp's** (parent company) plant in Marion, Ind.

Magnaflux Corp, Chicago, has appointed **James E Heath** vice president, manufacturing. He was formerly director of manufacturing for the Mechanical Division, General Mills Inc, of which Magnaflux is a wholly owned subsidiary. **A E Christensen** has been named Magnaflux manager of engineering.

Taft-Peirce Manufacturing Co, Woonsocket, RI, has appointed **Carl B Klockars** to the newly created post of assistant manager, machine tool sales. He moves up from the position of Eastern New England sales representative.

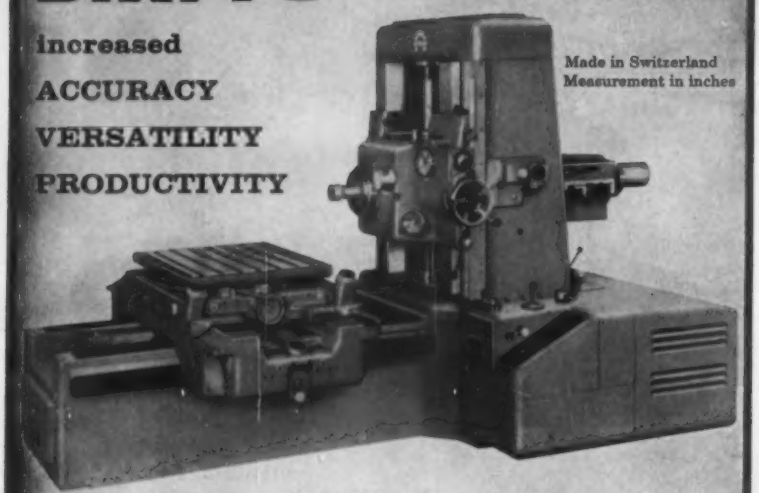
Boice Gages Inc, Hyde Park, NY, has appointed **James Damato** vice

CUT ACCUMULATED ERRORS to a minimum

with the

DIXI 75 horizontal optical jig borer

increased
ACCURACY
VERSATILITY
PRODUCTIVITY



Made in Switzerland
Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting—direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
- Simplified controls functionally arranged for greater operating speed and efficiency
- 3" diameter boring spindle
- Increased capacity: table size 39⅜" x 32"; 29⅝" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel
- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York.—Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

Demonstrations upon request at our conveniently located demonstration centers.

MBI

M. B. I. EXPORT & IMPORT LTD.
A DIVISION OF MACHINERY BUILDERS, INC.
475 Grand Concourse, Bronx 51, N. Y.
Swiss Accuracy plus U. S. Know-how

NAMES IN THE NEWS...

president, manufacturing. He was formerly associated with Crosby Valve & Gage Co. **Raymond Isacsson** has been named regional sales manager for Boice in the midwest area.

Yale & Towne Manufacturing Co, New York, has elected **Gordon Patterson** president to succeed **Gilbert W Chapman** who has retired. Mr Patterson previously was president of Square D Co

Sunbeam Equipment Corp, Meadville, Pa, has elected **Vincent R Troglione** president to succeed **H C Gwinn,** named board chairman. Mr Troglione was formerly vice president and general manager of this industrial furnace firm

American Machine & Foundry Co has appointed **Russell J Keller** general manager, Buffalo plant. He was formerly general manager of the AMF Welding Division in Cleveland.

SKF Industries Inc, Philadelphia, has named **William C Wright** to the newly created post of general manager, Altoona division. **James A Graham,** formerly plant manager, Philadelphia, succeeds Mr Wright as production manager. **Stanley Kabala,** formerly Altoona plant manager, has been appointed plant manager, Philadelphia; and **Woodrow Wilson,** Altoona supervisor of

factory engineering and mair.tenance, has been named Altoona plant manager.

Gleason Works, Rochester, NY, has announced that **Frederick E McMullen,** vice president, engineering, has retired after 46 years of service with the firm

Society of Automotive Engineers has named **Joseph Gilbert** secretary and general manager. Mr Gilbert, SAE's assistant general manager since 1957, succeeds **John A C Warner** who has held the post since 1930

Avco Corp, Cincinnati, has announced that **John Mihalic,** a vice president of the corporation, and president of its Nashville Division, has also been named president of the Crosley Division to succeed **F C Reith** who died July 3.

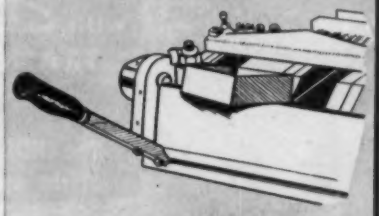
OBITUARIES

Charles G Allen, 84, general manager and treasurer of the **Charles G Allen Co,** Barre, Mass, manufacturer of drilling and tapping machines, died July 18.

Allen DeVilbiss Gutchess, 67, former president and chairman of the board of **DeVilbiss Co,** Toledo manufacturer of spray systems and finishing equipment, died July 1.

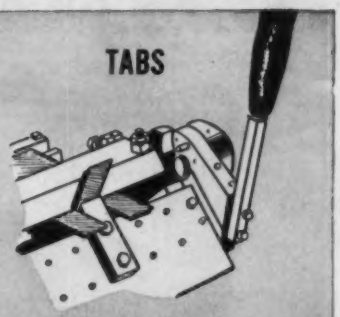
Raymond J Kraemer, 64, senior vice president and director of purchases for **R C Mahon Co,** Detroit, died June 30.

BOXES



Box fingers space to take box sides.

TABS



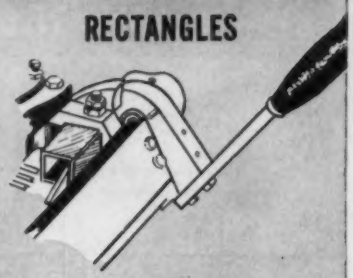
Bending Block does not disturb flat areas.

HOW TO FORM... Sheet Materials

HEMS

Acute angle is flattened in second bend.

RECTANGLES



Open end finger forms any closed shape.

with a

DI-ACRO BRAKE

For free booklet, "Handy Guides to Rod Parters," consult yellow pages under Machinery — Machine Tools for your nearest Di-Acro distributor or write us.

Find Us Fast in The Yellow Pages

The Di-Acro Brake is a six-in-one precision metal working machine simply tooled for a variety of jobs. Ten models in 6", 12", 18" and 24" widths handle up to 16 gauge mild sheet steel.

pronounced die-ack-ro

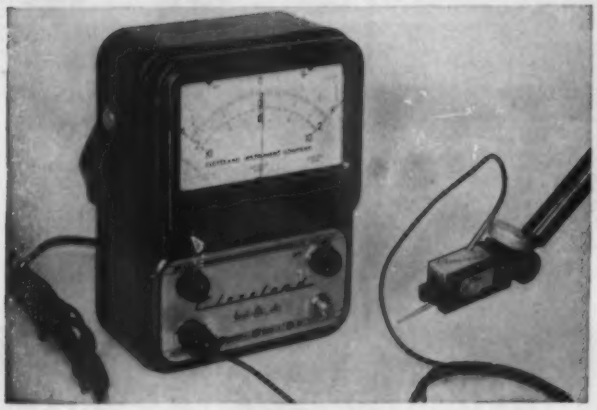
Consult the yellow pages of your phone book for the name of your nearest Di-Acro distributor or write for 16 page "Handy Guide" to Di-Acro Brakes.

di-acro PRECISION METALWORKING MACHINES

O'NEIL-IRWIN MFG. CO.

405 Eighth Avenue • Lake City, Minnesota

NOW HIGH PRECISION FOR EVERY SHOP AREA



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TRANSISTORIZED INDICATOR
INDI-AC, Jr.
The INDI-AC, Jr. embodies most of the features of the standard INDI-AC electronic indicator

☆ **OPERATES ANYWHERE**
Portable — 4½ pounds — 6" x 7" x 3½"
AC and permanent, chargeable battery, operated
Unaffected by shop conditions

☆ **USE FOR ANY GAGING PURPOSE**
3 scales — thousandths — tenths — millionths
Zeros and readings coincide on all scales
Reversible action gage head. Eight Tip Pressure.

☆ **NO MAINTENANCE PROBLEM**
Exclusive PROTECTOR TIP*
No battery replacement
Long life transistors
No mechanical parts to wear

other CLEVELAND PRECISION INSTRUMENTS

INDI-AC—Ultra-Precision Electronic Height Gage

MICRO-AC—Electronic Micro-Comparator

INDI-RON—Ultra-Precision Roundness, Squareness and Concentricity Gage

ROUGHNESS METER—For surface finish measurement

Write for free Wall Charts "Sources of Measurement Error"

*Patent Applied For.

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by the world's leading **CAM** manufacturer

Write for Bulletin No. 105
which completely details and outlines
how you can
SAVE 2,300%
on engineering computation alone

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"Good heavens, Ambrose . . . you mean we're completely out of them?"

Disturbing as it seems, people occasionally run out of Jewel Brand Abrasive Belts. Fortunately, they can replenish their supply quickly and easily through their nearby Industrial Distributor. Check *your* stock now!

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COATED ABRASIVES
Belts • Rolls • Sheets • Discs • Specialties
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CIRCLE 243 READER SERVICE CARD

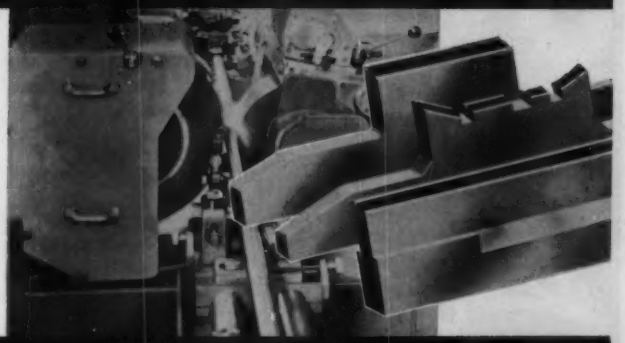
CIRCLE 244 READER SERVICE CARD

. . . THREE TALIDE CASE HISTORIES

Talide® BLADES for centerless grinding

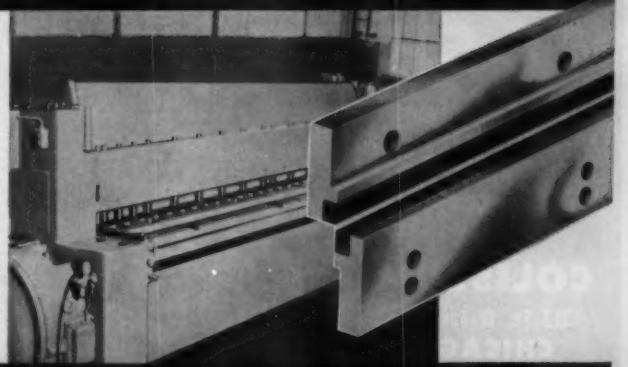
25 YEARS OF TOP PERFORMANCE

using Talide-tipped work support blades on Landis, Cincinnati and Van Norman centerless grinders. Available in lengths up to 120". Tipped with a ONE-PIECE carbide wear strip. No section or seam marks to score or scratch the work. Users prefer blades of Talide superior construction. Over 50 sizes and styles of standard blades are carried in stock. Special blades made promptly to order.



Talide® BLADES for shearing

5,631,000 CUTS WITH 59" LONG TALIDE SHEAR BLADES on a Keystone Shear at Westinghouse Electric cutting 29 gauge silicon steel up to 36" wide. 8 months' service life between regrinds saved $2,000 in grinding and set-up time. During this same period it was previously necessary to grind high-carbon, high-chrome blades 24 times — and make frequent replacement. Talide blades normally stay on the job for several years giving high-speed, continuous, burr-free production.



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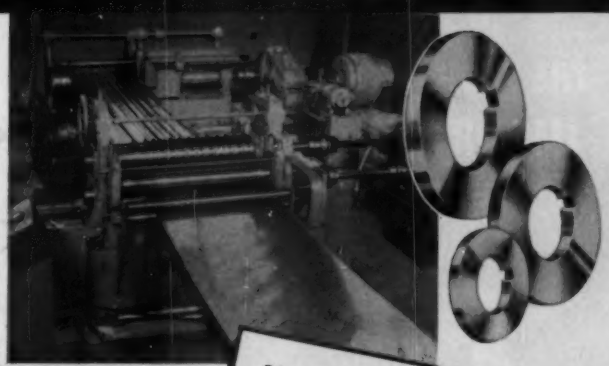

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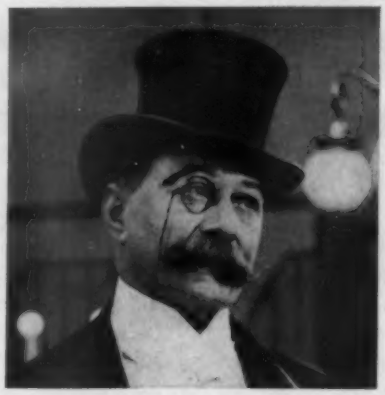

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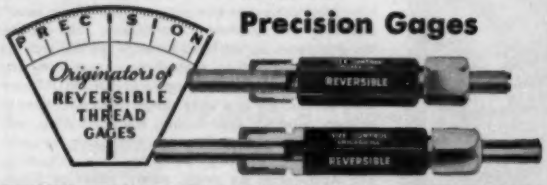

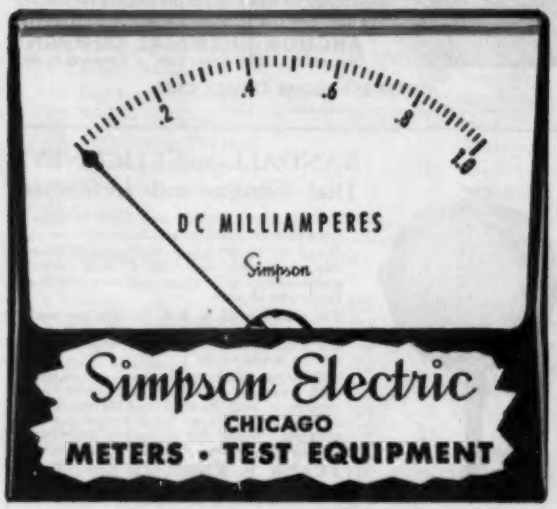

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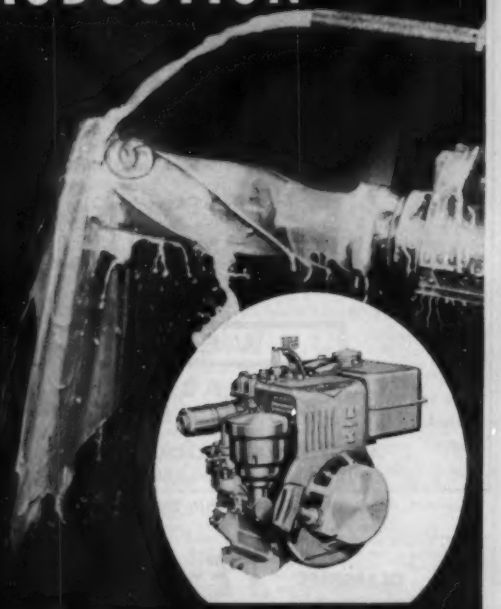

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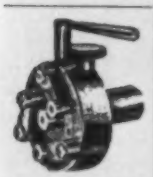

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10" ¼" Webb Roll, 1946
#5H K & T Plain Mill, Late
30" x 84" c American Lathe, Late
¾" Kane & Roach Shape Straightener
27" x 22' c Niles Lathe, Late
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DRILL BLANKS
REAMER BLANKS in
Steps of .001"
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Listed below are used, surplus new and rebuilt machine tools or services as advertised in this section.

The numbers after the advertiser's name, indicates the products or services offered by the advertiser.

1. Accessories
2. Automatics
6. Boring Mills
7. Broaching Machines
16. Drilling & Reaming Machines
17. Electric Motors
18. Engraving Machines
21. Forging Equipment
24. Gear Cutting Machines
25. Grinding Machines
27. Honing & Lapping Machines
30. Lathes
36. Milling Machines
40. Planers
42. Power Equipment
43. Press Brakes
44. Presses
45. Punches
49. Roll Formers
51. Saws
53. Shapers
54. Shears
60. Threading & Tapping Machines
63. Welding Equipment

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at its Best

Two of Miles 25 year men scraping in a grinder bed to new tool tolerances—one of the many operations which make Miles rebuilt tools perform like new.

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Grinder, Cylindrical, 12" x 40" Cincinnati Universal Filmatic
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Grinder, Internal, No. 72A3 Heald Gagematic
Grinder, Internal, No. 5 Bryant
Grinder, Surface, 6" x 18" No. 2 Brown & Sharpe
Grinder, T & C Type HRS Barber Colman hob, cutter and reamer
Grinder, Reinecker vertical spindle precision, internal-external, etc.
Hone, No. 172 Barnes, hydraulic, single spindle, vertical
Lathe, Automatic, Model 10 x 36" Sundstrand, new 49
Lathe, Engine, 16" x 56" ee American Pacemaker
Lathe, Production, 15" x 30" ee Lipe Carbomatic, hydraulic
Lathe, Turret, No. 2 Warner & Swasey, new electric bar feed
Lathe, Turret, No. 5W Acme Universal, hard ways, Timken bearing
Mill, Duplex, No. 34-36 Cincinnati hydromatic, tracer controlled
Mill, Boring, Horiz., 4" bar Universal Tri-Way
Mill, Boring, Vertical, 62" King
Mill, Plain No. 2 Cincinnati high speed dial type
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Shaver, Type KK Economy automatic bolt head shaver or pointer
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Press, Coining, 250 ton Model 90-250 Minster, late
Press, Horning, 90 ton No. 75 Bliss Consolidated
Press S.S., 150 ton No. 57 Toledo tiered frame
Press, OBI, 45 ton No. 5A Toledo
Press, Punching, 70 ton No. 35P Toledo
Roll, No. 18 Kane & Roach straightening
Saw, 7" capacity No. 14 Higley cold metal
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100 tons, Bliss #5-36, Bed 36"x28"
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RCG = Reconditioned—Guaranteed
*Indicates 1940+ Model **Indicates 1950+

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**1¾"—6 spdl Conomatic, shanker
**⅞"—6 spdl Conomatic w/Thrdg.

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*24" Bullard VTL w/Side Head RBG
*74" Bullard "Cutmaster" VTL Excel. RCG
*4 Sellers Horiz. Tbl. Type (1942)

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*3' x 11" Carleton, Tap'g Bar IA-322
*4'x11" Amer. "H. Wizard" Tbl. (1943)
*5'x11' Carleton #4 MT, Ser. IA1418

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**8 ton—42" Cine. Vert. Hydro (1950) RBG

GRINDERS, MISC.
**100 Sheffield, Multiform (1957) Like New
*#35 Excello Thread, 3 way dresser, RBG
*100 Bryant Int. New Spdl. (1947) RBG.
**10x24 #4BGI Van Norman Ext. 20 HP (1955)
**30 x 48 Landis CHW Ext Like New
*2 Cinc. Centerless, Hydr Profile Dresser RBG

GRINDERS, SURFACE
*18A2 Blanchard 2 spdl. autom. Sz'g. (1948)
*30 x 36 x 120" Thompson Horiz. Hydr. (1948)

JIG BORER
*1830 Clearman, 1000 RPM, RA1 Ser CJB187

LATHES
*12 x 20 Rivett 1020, T.R. Model (1950) RBG.
**20 x 72 Monarch Tracer, Thrdg., etc. RBG
*30 x 96 Niles "Timesaver" T.A. SJ, 4J RBG
*74" Star "T" Lathe, 15 HP Like New
**30H Bullard Manutrol 3 Spdl, Ser. 26104

LATHES, TURRET
*23 Gisholt, Barfeed, 1948, Excel.
**25 J&L, Hard. Ways, Access (1951)
**3A W&S with Access. (1953) & (1943)

MILLS
**BE30 Mammut (German) Horiz. H.D. (1953)
**V-30 Mammut (German) Vert. H.D. Univ. (1954)
**24 Cinc. Vert. H. Speed Dial Type (1954)
*#1 Gorton Vert. 4000 RPM RCG
**26CK K&T Horiz 18 x 100 Tbl, 25 HP (1953)
**33—2448 Sundstrand Rigidmill 15 HP (1952)
*#33—1448 Sundstrand 600 RPM (1944)
*#4-48 Cinc. Hydrom., R & F Tracer, RCG
*56 x 90 Cinc. Hydrom., Simplex RCG
*28-60 Cinc 1 Spdl Vert Hydrotel, RCG

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5' x 5' x 14' converted planer type, Rblt. Cond.
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**65 Ton Federal OBI 4" Str., Air B—RCG
*110 Ton AS Niag. OBI, 6" Str RBG
*300 ton Verson Hydr. 44x60 bed, 28" str., 125 HP

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*20" DoAll Vert. Bandsaw W/Welder
**36" DoAll H.S. Vert. Bandsaw, Hydr. Tbl (1958)

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THE SIGN OF QUALITY— THE MARK OF DEPENDABILITY

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36"x36"x8' Cincinnati, m.d., 2 heads on rail
36"x36"x12' Betts, m.d., 3 heads
36"x36"x12' G. A. Gray, 2 heads
36"x36"x18' table Cincinnati Double Housing, m.d.
36"x36"x20' table Cincinnati H.P. Double Housing, m.d., bolted
48"x48"x18' Niles-Bement-Pond, 2 heads, belt
48"x48"x28' Cincinnati, reversing m.d., 4 heads
56"x42"x14' Cincinnati, belt drive, 2 heads

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E. W. Bliss-Toledo Machine Tool Div. Horn or "Overhang" Press, late
No. 6 Verdin, Kappes & Verdin Straight Side
No. 6F E. W. Bliss Three Crank Cupping Press
No. 1045½ Toledo Toggle Drawing & Deep Stamping
7½ ton Froneh Oil Mill Machine Co. Straightening, m.d., 1942
100 ton Wood Model 8229 Vertical Hydraulic, 4 col. Single action-down
600 ton Niles Horizontal Wheel Press
Type 8250 Hennifin Hydraulic Straightening, m.d.
No. 3AA Canco (American Can Co.) Open Back Inclinable Punch Press, m.d.
No. 18C Bliss Open Back Inclinable Flywheel Type, bolted drive
No. 24A Bliss Consolidated Horn Press, m.s.

PROFILERS
Model BL 2416 Pratt & Whitney Keller Type, m.d.
No. 12B P & W Model 1695, 2 spindle, 1944
No. 12M Morey, 2 spindle, m.d., 1943
4 spindle 360° Cincinnati Automatic, m.d., 1944
30" capacity 2 spindle Pratt & Whitney Vertical Miller & Profiler, Model 1462

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60 Border St., East Boston, Mass.

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STAMPING & FORGING EQUIPT.

1300-Ton Nat'l. Maxipress, 80 SPM, 10" Str. Mfg. 1955
920-Ton Toledo #80—Bed 47 x 72, Stroke 20" 1943
700/200-Ton Toledo #797E—Bed 127x85—Dbl. Act. Toggle Air Clutch & Cushion
600-Ton Ferracute E80!—Coining, 6" Str. 30 SPM, Mfg. '50 Bed 37x36 (1950)
440-Ton Bliss #210, Bed 37x88, 85 SPM, Side Shear, Stroke 16", Mfg. 1953
440-Ton Toledo #59¼, Bed 41 x 48, Stroke 12"
235-Ton Bliss #208, Bed 30x54, Str. 8"
255-Ton Toledo 36½B, Bed 43 x 42, Stroke 12"
150-Ton Clearing E2150, Bed 45x36, Str. ⅜"
150-Ton Cleve. 60-D-84, Bed 96 x 46, Stroke 14"
88-Ton Toledo #7 OBI, Str. 6", 30 SPM
3000# Chambersberg "Cave Drop" Hammers, Mfg. 1951

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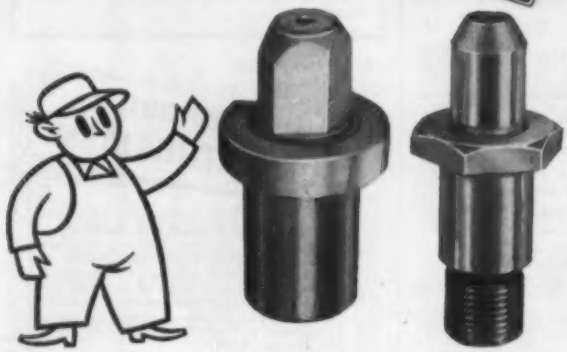

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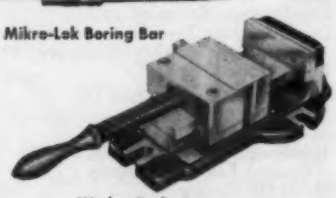

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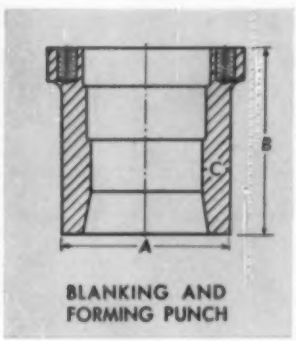

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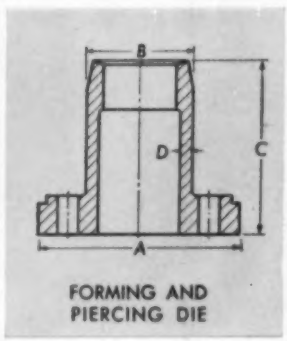

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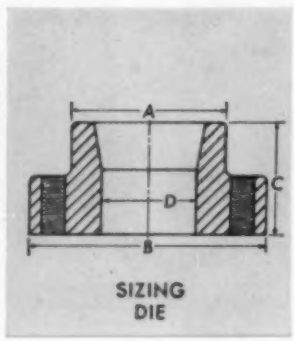

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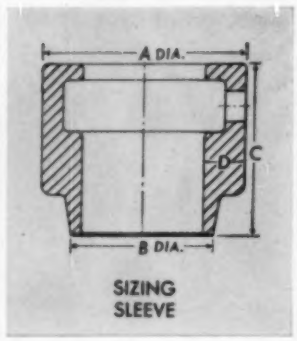

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